Proceedings of the Symposium '90 for Veterinary Epidemiology, Zoonoses, and Economics

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Sponsored by
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of the United States Department of Agriculture

Introduction to Symposium '90

Each year the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) and the American College of Veterinary Preventive Medicine (ACVPM) sponsor a symposium to focus on significant issues in veterinary epidemiology, zoonoses, and economics. The ACVPM focus for Symposium '90 is "Emerging Diseases of Veterinary Interest."

The Symposium presents an opportunity for APHIS veterinarians to share results of their work with other colleagues in the veterinary public health sector. In addition the Symposium allows the group to identify diseases or topics of interest for special lectures and discussion.

These Proceedings are a collection of the papers or abstracts of the talks presented at the Symposium '90, held November 13-15, 1990, in Landover, Maryland.

Compiled and Edited

by

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For more information about the Symposium, please contact Dr. Wilson at USDA/APHIS/RD, 555 South Howes Street, Suite 100, Fort Collins, Colorado.

Acknowledgements

Many thanks go to all the people of the Animal and Plant Health Inspection Service and the American College of Veterinary Preventive Medicine who helped make Symposium '90 possible. Special thanks to William Hueston of APHIS and ACVPM who worked with program development. Monica Lorenzano of USDA/APHIS/RD deserves special thanks for her help and support with this project.

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Emerging Diseases of Veterinary Interest

Canine Lyme Disease: How Real the Threat

by

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Although a critically important human disease, Lyme borreliosis may not be a disease of dogs or cats at all, but only an immunologic response to an organism that remains of questionable pathogenicity for these species. Although this suggestion may represent heresy to veterinarians who routinely diagnose Lyme disease, I would offer several forms of indirect evidence that provide the basis for this concern. *Borrelia burgdorferi* has been recovered from several species of wild and domestic animals, but despite extensive research efforts, no one has yet successfully induced the disease in immunocompetent dogs by experimental inoculation of the organism. Despite the description of skin lesions resembling erythema chronic migrants in guinea pigs and rabbits, polyarthritis in infant rats, and multi systemic disease in the severe combined immunodeficiency mouse, experimental inoculation of *B. burgdorferi* has not resulted in apparent illness in an immunocompetent animal host.

In endemic regions, the organism is nearly ubiquitous in ticks; canine[1] and feline[2] exposure is extensive; in selected dog populations, seroprevalence can approach 90%. In addition, spirochetemia has been documented in asymptomatic seropositive dogs, suggesting the possibility of natural immunization[3]. In contrast to human borreliosis, antibody titers fail to decrease following "appropriate" antibiotic treatment in symptomatic dogs[3,4] and high antibody titers to *B. burgdorferi* can persist, relatively unchanged in asymptomatic dogs for years (unpublished data). Immunoblot analysis of the IgG response to *B. burgdorferi* indicates that naturally exposed dogs from different geographic regions of the United States experience exposure to an antigenically similar organism.[5] Again, in contrast to the variability in immunoblot pattern associated with various stages of human borreliosis, there is no difference in the immunoblot pattern between symptomatic and asymptomatic dogs with high *B. burgdorferi* antibody titers.[5] Serologic support for a pathogenic role for the organism in dogs is lacking.

Although the initial case report of canine Lyme disease was convincing, two of Koch's postulates were not satisfied, i.e., induction of disease in a susceptible dog with the cultured organism and reisolation of the organism from the experimentally infected animal. Much of the literature that has followed this initial report is based upon a serologic diagnosis of Lyme disease in dogs from endemic regions where seroprevalence may reach 90%.[1] Since seropositivity, rather than seroconversion was used as the criterion for diagnosis, the relevance of these cases to the actual clinical spectrum of canine or feline Lyme disease is highly suspect. Even more recent reports, in which the organism was isolated or demonstrated by monoclonal antibody technique in tissues, fail to demonstrate an absolute cause and effect relationship. This concern would not be quite so bothersome, were it not for the fact that Burgess[3] was able to isolate the organism from blood in 8/111 healthy dogs from U.S. Department of Agriculture licensed vendors in Wisconsin. Considering the historical difficulty in growing the organism in modified Kelly's medium, it is possible that even more dogs may have been spirochetemic. These results suggest that the demonstration of antibodies or antigen in dogs from endemic regions during the tick season may merely reflect exposure to and transient infection with

the organism, rather than being diagnostically significant. Carefully structured long-term controlled studies are needed to establish what proportion of antibody or antigen-positive dogs subsequently develop disease.

There are obvious deficiencies in the availability of scientific information related to the pathogenesis, diagnosis, treatment, and epidemiology of canine and feline Lyme disease. Regrettably, it is possible that we are developing a large body of clinical information, based primarily upon serologic evidence, that may or may not represent an accurate description of Lyme borreliosis in our domestic animals. The interpretation of this information, if inaccurate, contributes to considerable patient morbidity in both endemic and nonendemic regions through misdiagnosis and improper treatment. It may have also contributed to the development and use of a vaccine for a disease that exists only on the pages of our journals. Since the seroprevalence of canine borreliosis in North Caroline is low[6] (less than 4%) routine vaccination for Lyme disease would not seem appropriate unless dogs posed a significant risk for human Lyme disease. A seroepidemiologic survey conducted in a Lyme endemic region found that dog ownership was not a risk factor for human *B. burgdorferi* infection.[7] Additionally, vaccination will eliminate the dog as a valuable serologic sentinel for documenting potential exposure to *B. burgdorferi*.

Future research to define the clinical spectrum of Lyme disease in dogs and cats should incorporate a rigidly defined case definition. Until the pathogenicity of *B. burgdorferi* for pet species is clearly established, veterinarians should maintain a degree of skepticism when contemplating a diagnosis of Lyme disease in their patients.

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Occupational Risk Assessment of Lyme Disease in Wisconsin Dairy Producers

by

Gayle Miller, Jeff Farrar, Jay Butler,
and the U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Public Veterinary Practitioner Career Program
Class of 1990

Abstract.--From 17-24 August 1990, 25 USDA/APHIS Public Veterinary Practitioner Career Program (PVPCP) veterinarians conducted a Lyme disease occupational risk assessment in Barron County Wisconsin. As Part of the six-month training program for recently hired USDA/APHIS PVPCP veterinarians, the USDA/APHIS Recruitment and Development Staff provides three weeks of didactic epidemiology course work along with a one week field exercise to reinforce the principles learned in the classroom.

In cooperation with the Centers for Disease Control, Division of Vector Borne Infectious Diseases, the USDA/APHIS/VS National Animal Health Monitoring System (NAHMS), the Wisconsin Departments of Health and Agriculture, and the USDA/Agriculture Research Service, organized a field epidemiology exercise. This exercise was established to address the current concern of whether dairy producers in one endemic county in Wisconsin were randomly selected from state milk ring test lists and compared with 57 non-livestock farmers to ascertain if dairy cattle production provides an increased risk of exposure to the agent of Lyme disease.

Questionnaires were administered to all consenting humans greater than 2 years of age regarding demographics, occupational history and activities, hobbies/leisure activities, raw milk/meat consumption, medical and travel histories, and tick bite recall. Serum samples were also collected from each participant on both dairy and non-livestock premises. For dairy producers, an additional questionnaire was administered to the farm manager regarding general farm management, milking facilities, and herd health history.

Serum samples were collected from each lactating dairy cow along with individual cow information relating to identification, breed, age, history of abortions, lameness, reproductive difficulties, presence of swollen joints, whether animals were purchased or raised, and recent antibiotic treatments.

Questionnaires and serum samples were collected from approximately 256 humans residing on dairy farms and from approximately 125 humans from nondairy premises. Over 2,500 sera were collected from dairy cattle along with individual animal data on the above mentioned parameters. Human serological analyses are in progress. Bovine sera will be banked until a suitable serological test is developed.

(Additional field exercises will be planned for future PVPCP classes. Ideas for future field exercises should be submitted to Dr. Nell Ahl, USDA/APHIS Recruitment and Development Staff, or to Dr. Frank Wilson.)

Management of Ebola Virus Infected Monkeys in a Primate Quarantine Facility

by

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A group of macaques (*Macaca fascicularis*) housed in a conventional primate quarantine and holding facility, were diagnosed to have a mixed infection of Ebola fever and Simian hemorrhagic fever. Ebola virus and Marburg virus (African green monkey disease) are the only known members of the family Filoviridae. Although experimental Ebola virus infection causes a severe and usually fatal hemorrhagic fever syndrome in nonhuman primates, naturally occurring disease in monkeys or other animals has never been reported.

The source or reservoir of the virus in Africa where periodic human epidemics of Ebola hemorrhagic fever occur remains a mystery; however, the primary mode of transmission in the African clusters of disease have been attributed to suboptimal handling of Ebola virus-infected tissues and blood products. Once Ebola infection was confirmed, the safe management and handling of a large number of monkeys potentially infected with a Biosafety Level 4 (BL-4) organism became the dominant issue. Because of our unique facilities, equipment, experience, and expertise in working with high-hazard organisms, the U.S. Army Medical Research Institute of Infectious Diseases was asked to assist in the management of the outbreak of disease. This presentation will describe the planning, preparation, equipment, containment, decontamination procedures, scope, and some of the unique problems associated with the management of the monkeys potentially infected with Ebola virus.

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Dr. Dan Dalgard and Dr. George Pucak

Outbreaks of Food-Borne Salmonella enteritidis in Humans

by

Don A. Franco

U.S. Department of Agriculture
Food Safety and Inspection Service
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Abstract.--The salmonellosis presentation highlights and reviews the predominant disease-causing serotypes including the variability in serotype virulence, characteristics of the genus, clinical characteristics, extraintestinal infectious, pathogenesis and pathology, reservoirs, modes of spread, and prevention and control. The presentation also covers pictures of the livestock and slaughter environment including other associated factors that contribute to the transmission of salmonellosis.

Update - APHIS Salmonella enteritidis Program

by

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I'm fortunate to follow Dr. Franco. He has pointed out the problems with salmonella in general and it serves as an excellent backdrop to talk about *Salmonella enteritidis*. I'm not really in agreement with him about the impossibility of controlling salmonella. I think he really means eradicating salmonella. But if you're talking about control, it's a question of degree. At what level are you willing to live with salmonella? It was interesting to hear Dr. Franco say that we should have at least 25 years to develop a program. As you will see in a few minutes, APHIS had to develop a program for *S. enteritidis* on an emergency basis, and it had to be done quickly. I'm going to present some facts that led to the start of our program, and I'd like you to consider what kind of program should have been proposed, especially with the knowledge you have of salmonella in general, and what it does in other animal species.

I'm not going to go into a great deal of detail about the different serotypes. *S. enteritidis* is one of the more than 2,000 serotypes. Up until the middle of the 1970's *S. enteritidis* was one of many serotypes--it was one of the many that are not host-adapted. It was found considerably in poultry, but also in cattle and pigs, lizards, and other cold-blooded species. There was no particular notice of *S. enteritidis* up until the middle of the 1970's. From 1976, going into the '80's, people began to notice that there was an increasing number of *S. enteritidis* isolates from humans and that more and more *S. enteritidis* was found to be the cause of human outbreaks of salmonellosis, particularly involving eggs. Now, this was not something that was noticed very easily. A group at CDC, that deals with enteric disease, noticed that there seemed to be a pattern, a concentration of cases caused by *S. enteritidis* implicating eggs, but particularly fresh eggs. And they noticed also, very surprisingly, that these outbreaks seemed to be concentrated in the Northeastern United States (Fig. 1). The group at CDC published a paper in the JAMA in 1988 after reviewing hundreds of investigations and pointed this out. I think this was really the start of the discussion about what to do about *S. enteritidis*. It also was provoked by a number of outbreaks in New York State, which caused the State Health Department there to embargo eggs from a number of places. This caught the attention, I'm sure, of most of the industry.

As you probably know, *S. typhimurium* has always been the leader, the number one salmonella as far as human isolates is concerned; *S. enteritidis* more or less has been the second; *S. heidelberg* the third. But lately, *S. enteritidis* has bypassed *S. typhimurium* and is now the leader in human isolates. You can see the trend in Fig. 2 and 3. There's a straight line increase pretty much for *S. enteritidis*. *S. typhimurium* now seems to be decreasing, along with *S. heidelberg*. Dr. Franco mentioned that there seems to be trends over 10- or 15-year periods for different species. It may be that this is something that is happening as part of a universal trend, because we've seen the same increase in Britain and France for *S. enteritidis* (Fig. 4, 5). It may be that *S. typhimurium* is on the way down and *S. enteritidis* is still on the way up. It may take a number of years before it starts coming down. But interestingly enough, when you look at the concentration in the

Northeast, there is a definite concentration there which isn't seen with *S. typhimurium* or *S. heidelberg*. Even though *S. typhimurium* and *S. enteritidis* have the same total number of isolates, overall there is a concentration in *S. enteritidis* human isolates in the Northeast and the mid-Atlantic states. You can see this if we use percentages. For the Northeast, middle Atlantic, and south Atlantic, 74% of the isolates of *S. enteritidis* were from that area, compared with 48% for *S. typhimurium* (Fig. 6, 7).

Now, more and more, the perception is that any outbreak caused by *S. enteritidis* must be coming from poultry. We have to remember that there are also isolates from pigs, turkeys, bovines, and many other species. So, it shouldn't be automatic to say, well if it's *S. enteritidis*, it must be egg-implicated. The main thing about the fact that *S. enteritidis* was causing outbreaks was not that of simply another salmonella getting into food, from feces or some fecal contamination, but that it seemed to be coming from fresh eggs, eggs that had not been broken or cracked or soiled with feces. This had not been seen before, so there was a lot of consulting of bibliography to find out if it is possible that this could be caused by a vertical transfer from the chicken to the egg.

This was not contamination of the shell getting into pooled eggs. It was felt that this was something new. The question was, if it is something new, what are we going to do about it? Are we going to simply accept it in spite of the fact that people deal with eggs as a sterile food and they eat eggs raw and they will continue to do so?

With the increasing number of outbreaks caused by *S. enteritidis*, what should be done about it? I think that, with the action by the New York State Health Department and the FDA, there was an impetus to do something, and there was a great deal of discussion about who should do what and what should be done. There was a proposal by the FDA to test all flocks of layer hens. Now there are some 2,000 in the United States and each of them may run up to a million birds or more. There are 230,000,000 layer hens in the United States at the present time (Fig. 8). The idea was, if in fact this is something that is coming through the layers, we should be getting their eggs out of the table egg market so that humans won't be exposed. Obviously, this is not an easy thing to do. APHIS didn't really have a budget for it; in fact, it appreciated the idea that maybe we do need 25 years to get into a program like this. There was certainly some inclination to consider this mainly a public health program. Incidentally, *S. enteritidis* in poultry does not cause much disease. It's not really a serious poultry disease. But it is serious because *S. enteritidis* does produce outbreaks in humans.

What was finally proposed was basically to start with the human outbreaks. If, in fact, we're concerned about the outbreaks that are being caused by *S. enteritidis*, let's start with the outbreak, trace back to the flock of origin, if the outbreak was caused by eggs (an egg-implicated outbreak), test the flock and find out what occurred. If the flock was positive for *S. enteritidis*, we would stop the use of those eggs as table eggs. Our program started in February of this year and I'll describe what we've experienced since then.

We first had to circularize all the health departments--the state health departments and many of the county local health departments--to make sure that any report of a *S. enteritidis* outbreak came to our attention so we could ask for information to find out if it was egg-implicated. For 1990 we've received 67 reports of outbreaks caused by *S. enteritidis* (Fig. 9). Now, this is not simply getting a report. First, we have to satisfy ourselves that the outbreak really is egg-implicated. In large outbreaks, and these are the ones that usually come to our attention, there may be 200 or 300 people affected. They have eaten 20 to 30 different foods, at buffets or elsewhere, so there has to be painstaking interviewing and analysis of what they've eaten to come up with a statistical figure showing the probability that a particular food most likely caused the outbreak (Fig. 10). If eggs are the cause (I can tell you the different kinds of foods that eggs are used for), we

are going to have to say, O.K., if this is really so, we're going to find out where these eggs came from. And then we start tracing back to find out where the eggs are coming from.

I can tell you about some of the real difficulties we have. There may be one distributor who gets his eggs from three or four producers or three or four distributors who get their eggs from 10 different producers. So we have to tease apart all the evidence to find out where these eggs are coming from, or we're left with the possibility of perhaps treating all 10 flocks, 10 different producers. In any case, we urge the health departments to report. Of all the outbreaks that we have considered, only 23 of them have actually been egg-implicated, as far as we can determine. Of these, we have been able to trace them back to 12 different flocks. These were located in Maryland, Pennsylvania, Indiana, and Delaware. Fig. 11 shows you where these outbreaks occurred. These are all outbreaks, not just the egg-implicated ones. You do see even here a concentration in the middle Atlantic and Northeastern states.

When you take the egg-implicated ones alone (Fig. 12), you see a further concentration. These are the ones where we felt that eggs were implicated. These traced back to the flocks which were tested. Five flocks tested in Pennsylvania were positive both environmentally and on organ culture. One flock had already been depopulated and we didn't have to consider that. The producer tested another flock himself, and he told us it was positive and that he would take care of it. That makes six there. The one in Maryland was positive both environmentally and with organ culture. There was one in Delaware that was also positive in both. There was one in Alabama which we consider rather exceptional. It was positive environmentally, but negative on organ culture. There were three in Indiana. All were environmentally and organ culture positive. So after all this time from February on, we have six flocks in Pennsylvania, one in Maryland, one in Delaware, and three in Indiana.

One of the basic assumptions when this program first started was that *S. enteritidis* was mainly limited to the Northeast, with not too many flocks involved. There has been a lot of discussion about why it seems to be concentrated in the Northeast, with seven or eight different reasons given, but none of them are really very plausible. I think there must have been some kind of mutation of one strain or one isolate perhaps that made the organism more invasive. *S. enteritidis* has been around for a long time. It was often found in the gut but rarely in the organs or tissues of the birds. Whatever change took place to make the organism more invasive evidently occurred in the Northeast.

Fig. 15 shows the seasonal incidence which we've seen very often with almost every kind of salmonella food infection. You get an increase in the summer--whether this is because the birds heat up or the food heats up, we don't really know. You can also see this seasonal incidence when we group all the salmonella together.

We're hoping we're not going to get too many cases or outbreaks during the next couple of months and that it will take a while before the incidence goes up again. But this is what we found. And this is a very small series. This simply gives you a listing of the outbreaks and the places they occurred. Most of them are in nursing homes, restaurants, hotels, picnics, or summer camps (Fig. 16). You have to understand that we're getting the big outbreaks; we're not getting the single cases--one or two cases that don't come to anybody's attention. Even if they do go to a physician, the physician may not report them. We're talking about the big ones that come to the health departments' attention and mostly with people going to a hospital. The number of cases is deceptive. These are only the ones that come to someone's attention. Many of the milder cases are not reported and so the number of isolates may be a very small part of the total. Fig. 17 lists some of the foods that were supposedly the causes of the outbreaks. They were all made with fresh eggs that

supposedly were undercooked or mishandled. And in every one of these, I think we can safely say that there was mishandling of food. But that is not the question. The question is whether eggs were involved, whether the eggs were fresh, whether these eggs lead back to a flock, and whether the flock can be tested.

One of the things we want to be sure of is that the phage type, which is one way of identifying strains or isolates, is the same for the human outbreak and the outbreak in the flocks. In every case where both were determined, this has been seen. In some we find more than one phage type. In the environment we find a variety a phage types; in the chickens we find a few less (Fig. 18). Interestingly enough, if you do environmental testing, which really means drag swabs of the manure pits and swabs of the egg-collecting machinery, you find many different serotypes including, of course, the *S. enteritidis* (Fig. 19). But, if you look at what we find in the organs themselves, which is the next part of the testing, (we tested organs from 60 birds) we rarely find anything else but *S. enteritidis*, which is one indication that this really is an invasive organism. Now, what we don't know is whether all isolates we could get from around the country are invasive when we find them in the environment or whether the invasive strains are only found in the Northeast and the middle Atlantic states. That may be why there's a difference in incidence regionally.

Well, when we get to a flock, what we call a study flock, a flock where we notify the owner that his flock or her flock has been involved in an outbreak, then we do environmental sampling, drag swabs of the manure pits and the egg belt machinery. If the results are positive for *S. enteritidis*, this is taken as presumptive evidence that it is in the birds also. It takes about 10 days to get the results, but when we get them and they're positive, even if there's only one isolate for the whole premises, which may have a million birds, based on our regulation we stop the use of all the eggs from there as table eggs. They can be sent to what we call breaker plants for pasteurization.

Now, with the news and publicity about *S. enteritidis*, the people that have used pasteurized egg products are getting pretty wary about using an egg product from eggs that are coming from flocks that have *S. enteritidis*. Our program was set up so that the producer would not have to depopulate his flocks. He could still sell his eggs, perhaps at a loss, but he could still sell his eggs for pasteurization. All kinds of salmonella can be found in liquid egg material before it is pasteurized. Eggs that are sent for breaking may be cracked eggs or dirty eggs, and they may have some salmonella in them or on them, not just *S. enteritidis*, but also many other types. There is a suspicion that enteritidis may cause a more severe illness in humans. I'm not sure of that, but in any case, there's no reason to single out *S. enteritidis* and say that the prepasteurized egg material shouldn't be used because it has *S. enteritidis*, since the pasteurization process would kill all the salmonella present.

After the environmental testing, we test the birds. We start out with 300 birds, and do the *S. pullorum* serological test. Organ cultures are done on those that are positive and they are supplemented to get 60 birds. If there is at least 5% prevalence rate in the hen house, we should find some evidence of *S. enteritidis* if we test as many as 60 birds chosen at random. In any case, we may have a premises with five houses or 10 houses. We have one flock with 36 houses. Each one of them has anywhere from 70-80 to 100,000 birds in each house. One flock in Indiana has something like 2.5 million birds, which is producing about 2 million eggs a day. That means if they are restricted, 2 million eggs go to breaker plants immediately. And this in itself can upset the egg market throughout the entire United States.

When this program started, the FDA stated that if the APHIS program didn't succeed, they would start their own program. They are going to look at the number of human

outbreaks and other indices. There were 77 recorded by CDC last year and we have had 67 in 1990. The number of human cases is another index that can be used. You can have one outbreak with a thousand cases, or 10 outbreaks with 20 or 30 cases each. In any event, we're about even with last year. Human deaths is another measure. If there is an outbreak in a nursing home with a lot of elderly people who are immune-compromised you can suddenly have a number of deaths. This year so far we've had three. Last year it was estimated that 73% of the outbreaks implicated eggs. This year we have had 34%. In any case, to date, about 3.5 million birds have been put under restriction and more or less about 400 million eggs were sent to breaker plants. About 1.5 million birds have been sent to slaughter, perhaps when they were due to go or because the producer wanted to get out of this situation. In any case, this is what we've been able to do so far (Fig. 19).

So, the question remains, what kind of a program should we have? We have funds to last another year. Either we continue with the current program, or we go ahead with a bigger program. The fact is there are *S. enteritidis* outbreaks occurring. There was a large outbreak in Chicago very recently. There were something like 400 cases. Supposedly these all came from some bread pudding that was supposedly made with raw eggs. The bread pudding was made according to the recipe, but may not have been heated enough. The sauce was made with raw eggs, again supposedly not heated enough. The point is that on analysis, the bread pudding seemed to be at fault. The eggs used to make the bread pudding were traced back to the flock in Indiana--with 2.5 million birds. We're now preparing to go ahead and test this particular flock.

FIGURE 1

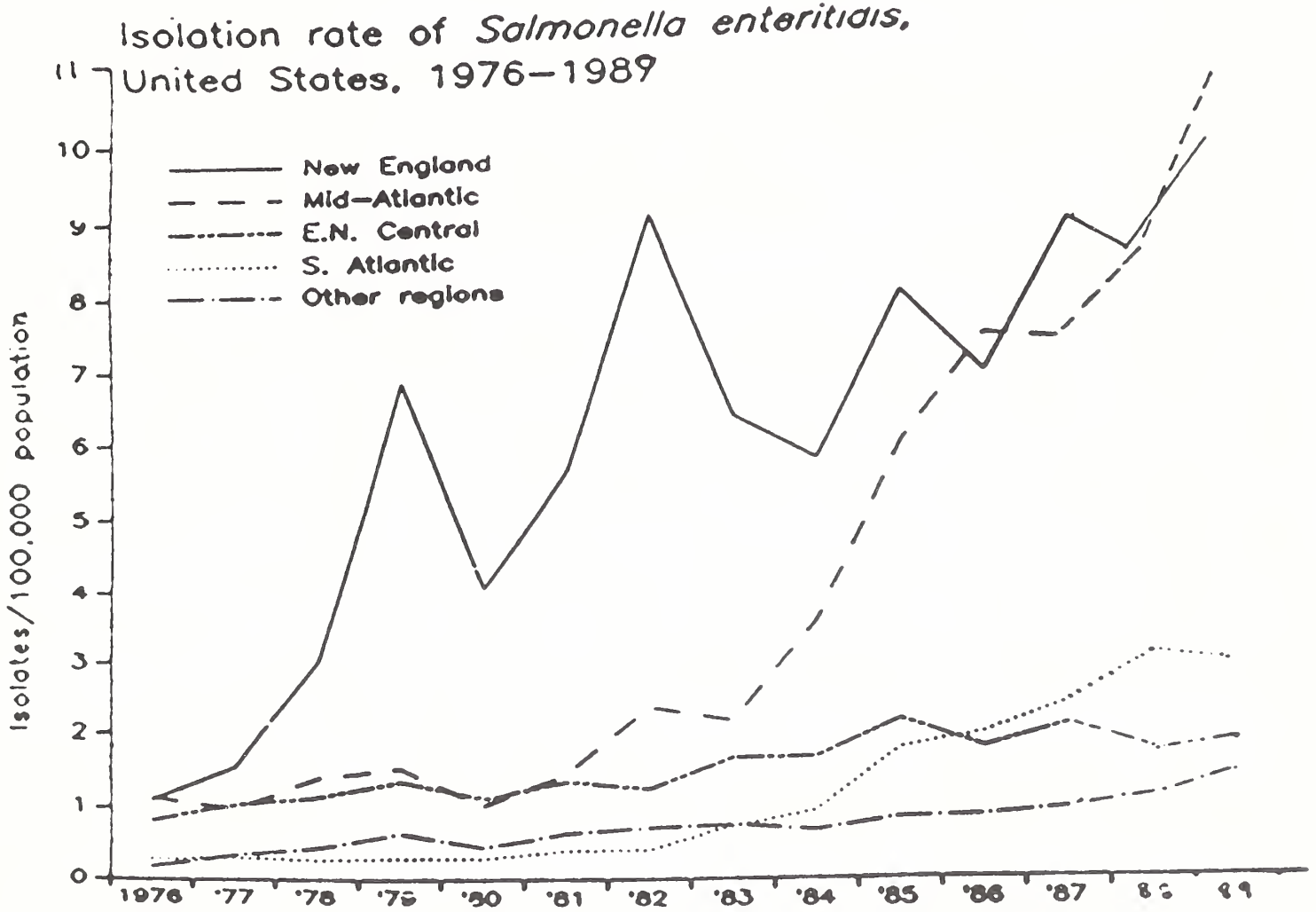
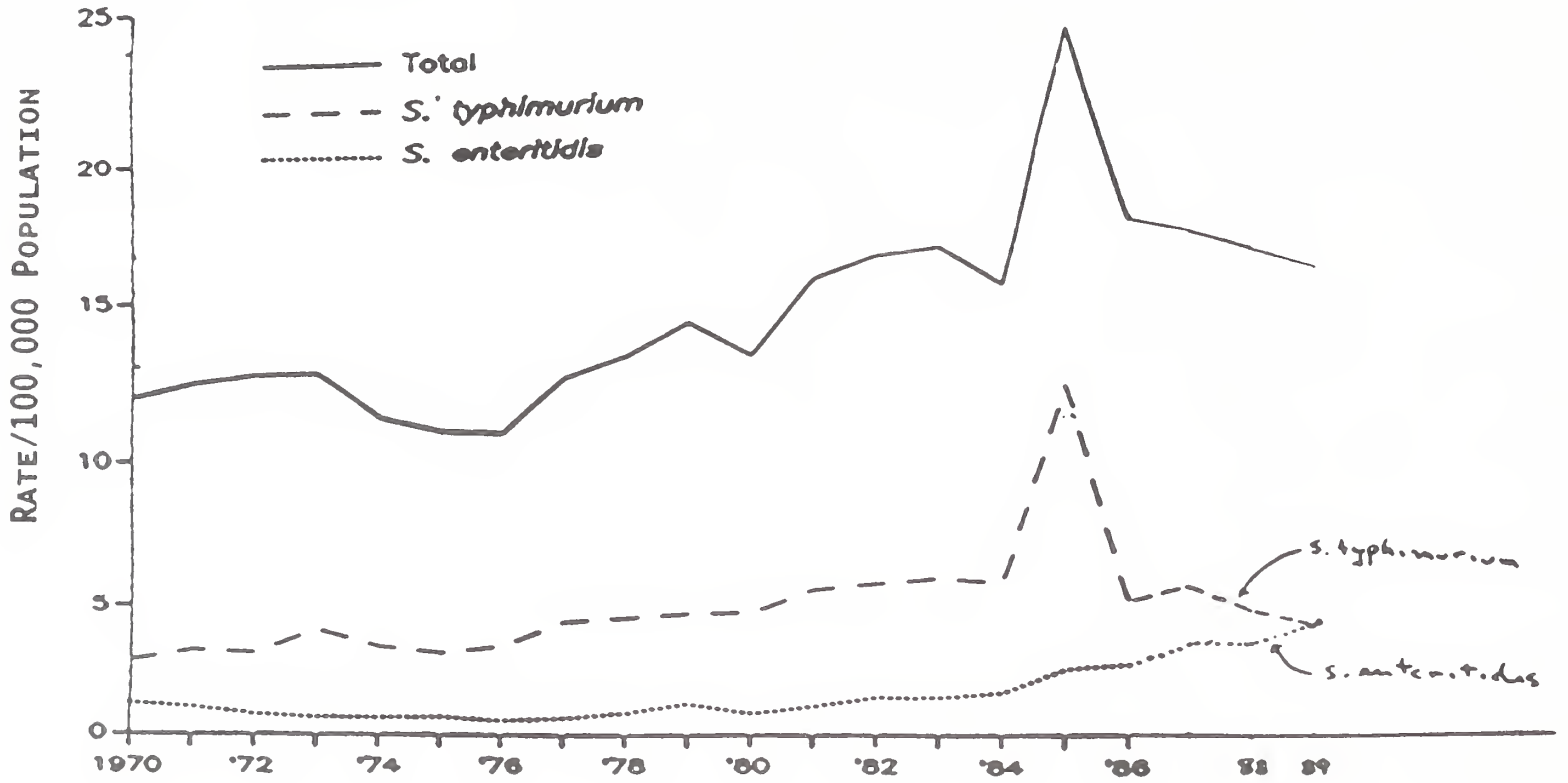

Isolation rate of Salmonella enteritidis,
United States, 1976–1989
New England
Mid–Atlantic
E.N. Central
S. Atlantic
Other regions
Isolates/100,000 population
0
1
2
3
4
5
6
7
8
9
10
11
1976
'77
'78
'79
'80
'81
'82
'83
'84
'85
'86
'87

FIGURE 2

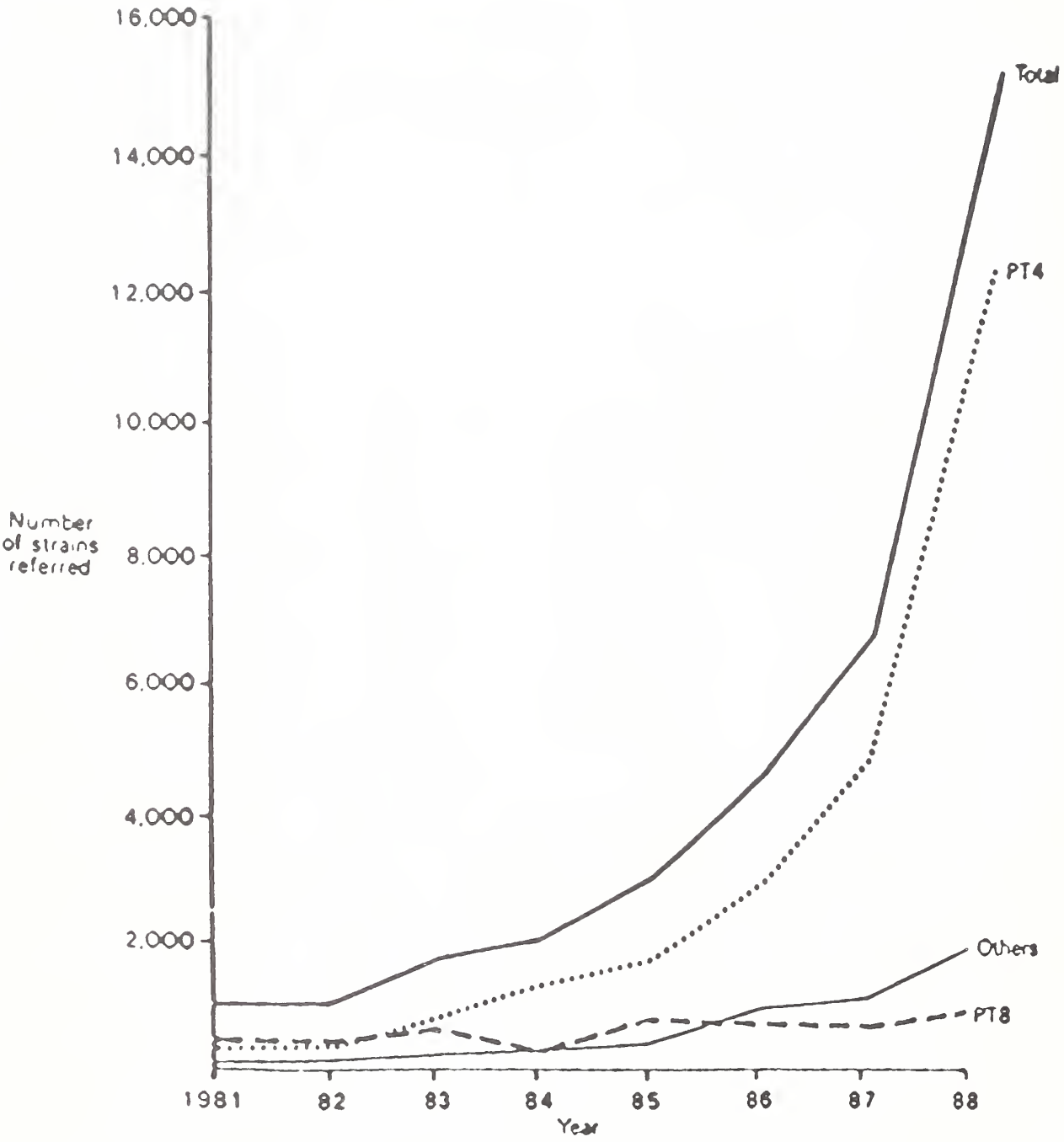
Salmonella isolation rate by total and selected serotypes and year--United States, 1970-1989



Human Isolates - U.S.

	SE	S. typhimurium	S. heidelberg
1979	2,694	9,978	2,515
1980	1,884	10,089	1,940
1981	2,532	11,991	2,051
1982	3,322	12,557	2,645
1983	3,256	12,934	3,746
1984	3,709	12,550	3,575
1985	5,611	28,034	5,196
1986	5,980	10,765	5,617
1987	6,976	10,364	5,731
1988	6,952	9,456	4,951
1989	8,340	8,306	4,479

SALMONELLA ENTERITIDIS
Strains referred to DEP from humans, by phage type
England and Wales 1981-1988



Source DEP

FIGURE 5

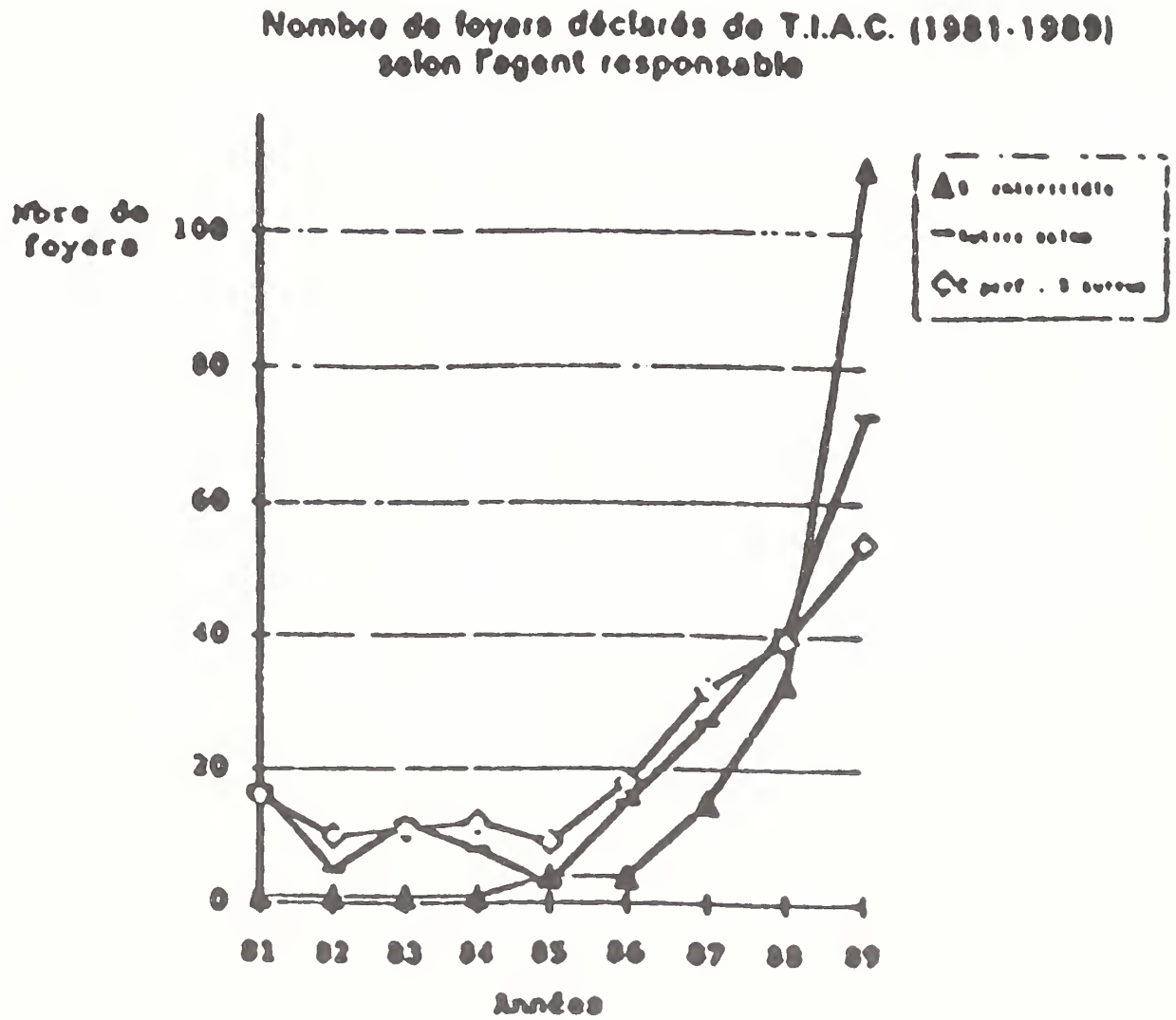

Nombre de foyers déclarés de T.I.A.C. (1981-1989)
selon l'agent responsable
Nbre de foyers
100
80
60
40
20
0
81
82
83
84
85
86
87
88
89
Années

FIGURE 6

Human Isolates - 1989 - U.S.

		SE		S. typhimurium		S. heidelberg
NE		1,220		735		323
Mid Atlantic	(74%)	3,955	(48%)	1,637	(41%)	854
South Atlantic	(6,209)	1,034	(3,949)	1,577	(1,830)	653
E. North Central		815		1,576		842
W. North Central		236		464		243
E. South Central		266		395		324
W. South Central		143		671		288
Mountain	(26%)	104	(52%)	328	(59%)	97
Pacific	(2,131)	567	(4,357)	923	(2,649)	855
	8,340		8,306		4,479	

FIGURE 7

REGION	1987 ISOLATES FROM HUMANS S. ENTERITIDIS	1987 ISOLATES FROM HUMANS S. TYPHIMURIUM	1988 ISOLATES FROM HUMANS S. ENTERITIDIS	1988 ISOLATES FROM HUMANS S. TYPHIMURIUM	1989 ISOLATES FROM HUMANS S. ENTERITIDIS	1989 ISOLATES FROM HUMANS S. TYPHIMURIUM
NEW ENGLAND	1,139 *	1,047	1,061 *	995	1,220 *	735
MID ATLANTIC	2,886 *	1,740	3,072 *	1,834	3,955 *	1,637
EAST NORTH CENTRAL	849	1,944 *	739	1,876 *	815	1,576 *
WEST NORTH CENTRAL	184	640 *	184	587 *	236	464 *
SOUTH ATLANTIC	1,026	2,170 *	1,119	1,867 *	1,034	1,577 *
EAST SOUTH CENTRAL	141	574 *	177	506 *	266	395 *
WEST SOUTH CENTRAL	101	763 *	93	604 *	143	671 *
MOUNTAIN	144	347 *	98	300 *	104	328 *
PACIFIC	480	1,088 *	409	887 *	567	923 *
TOTALS	6,950	10,313 *	6,952	9,456	8,340 *	8,306

FIGURE 8

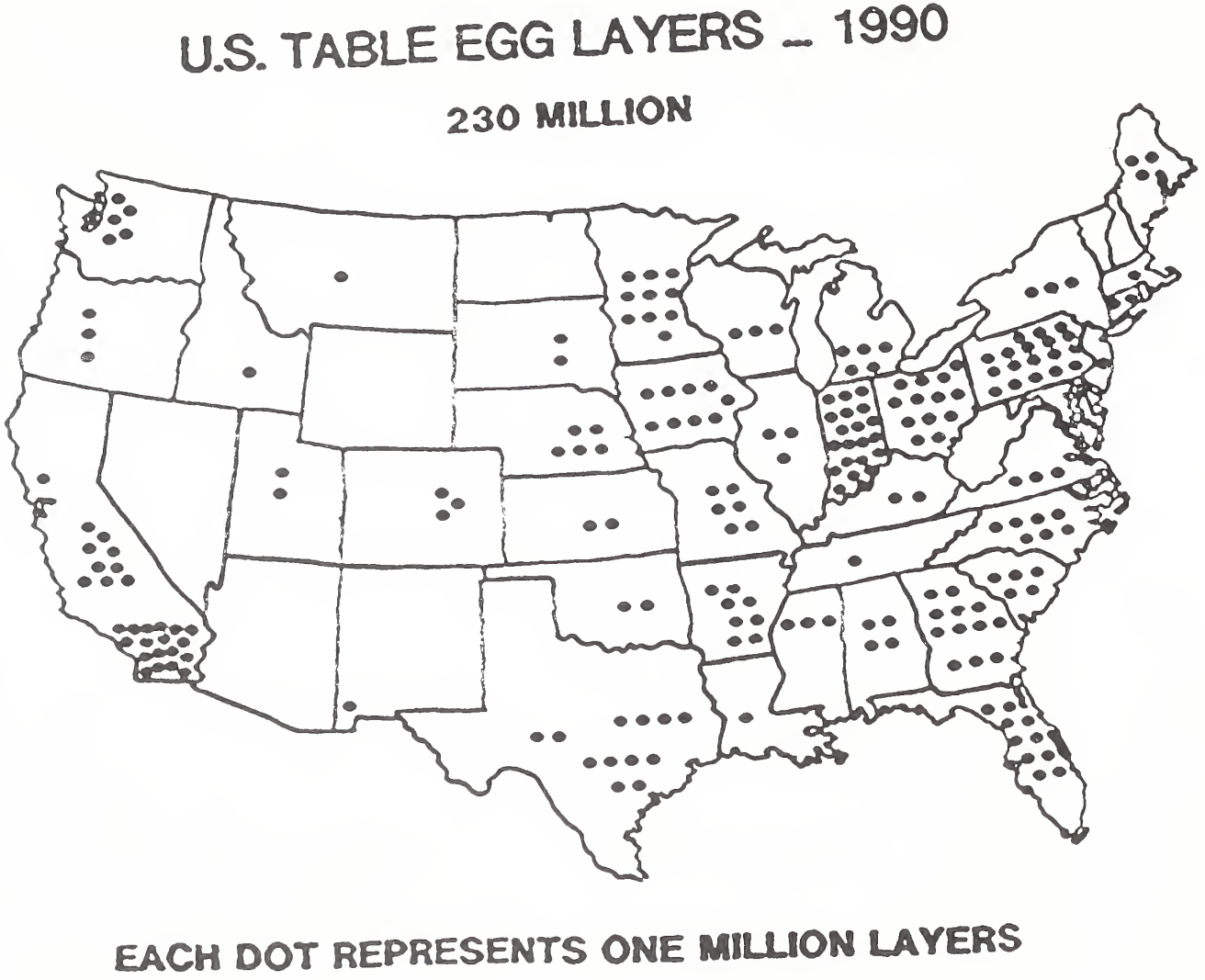

U.S. TABLE EGG LAYERS – 1990
230 MILLION
EACH DOT REPRESENTS ONE MILLION LAYERS

FIGURE 9

SUMMARY OF HUMAN SE OUTBREAK INVESTIGATIONS REPORTED BY PUBLIC HEALTH AGENCIES - 1990

COMPLETED INVESTIGATIONS 67

EGGS IMPLICATED 23

ALL OTHERS 44

TOTAL REPORTED OUTBREAKS 67

SOURCE: USDA, APHIS, VS, SE TASK FORCE

FIGURE 10

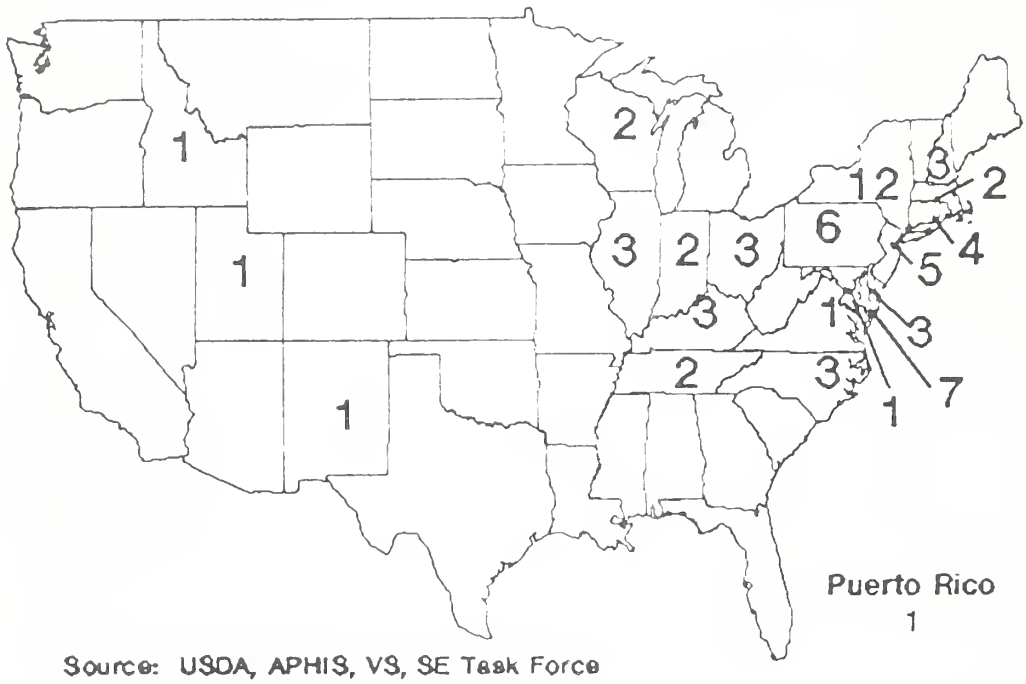
EGG CONTAINING FOODS IMPLICATED IN HUMAN SE OUTBREAKS REPORTED IN 1990

EGG FU YUNG	CRABCAKE MIX	CHEESECAKE
BANANA PUDDING	OMELETTE	EGGS BENEDICT
QUICHE MIX	CEASAR'S SALAD	FRENCH TOAST
ICE CREAM	CAKE FROSTING	BEARNAISE SAUCE
HOLLANDAISE SAUCE	QUICHE	LASAGNA
SCRAMBLED EGGS	MILK SHAKE	CREAM PUFFS

Source: USDA, APHIS, VS, SE Task Force 1/18/91

FIGURE 11

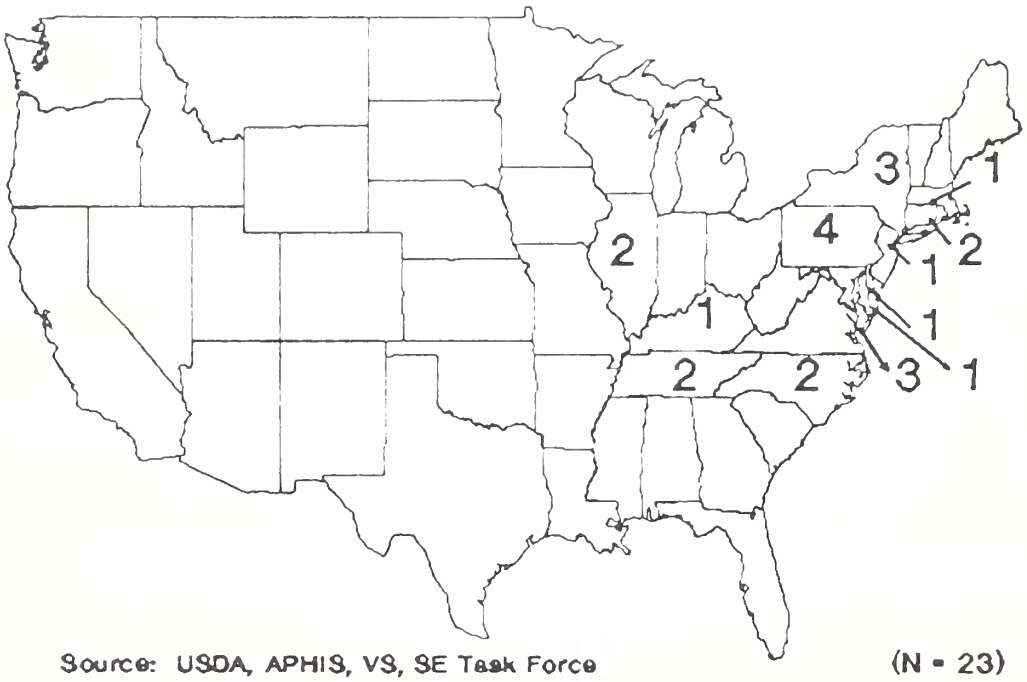
Location of Human SE Outbreaks
Reported to USDA - 1990



Source: USDA, APHIS, VS, SE Task Force

FIGURE 12

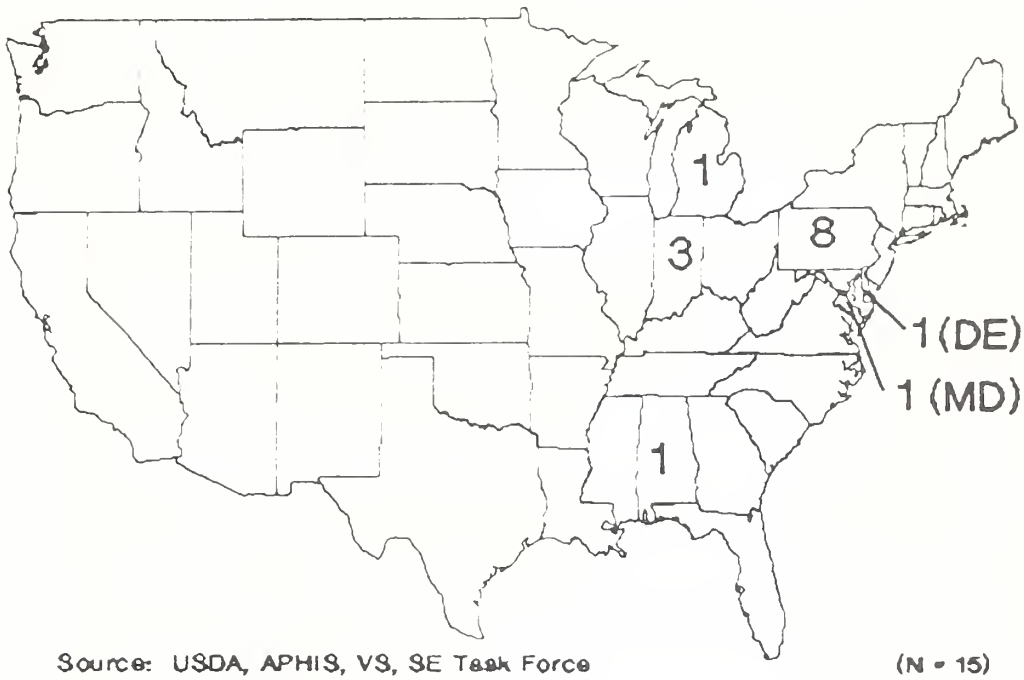
LOCATION OF EGG ASSOCIATED OUTBREAKS
REPORTED TO THE SE TASK FORCE IN 1990



Source: USDA, APHIS, VS, SE Task Force (N = 23)

FIGURE 13

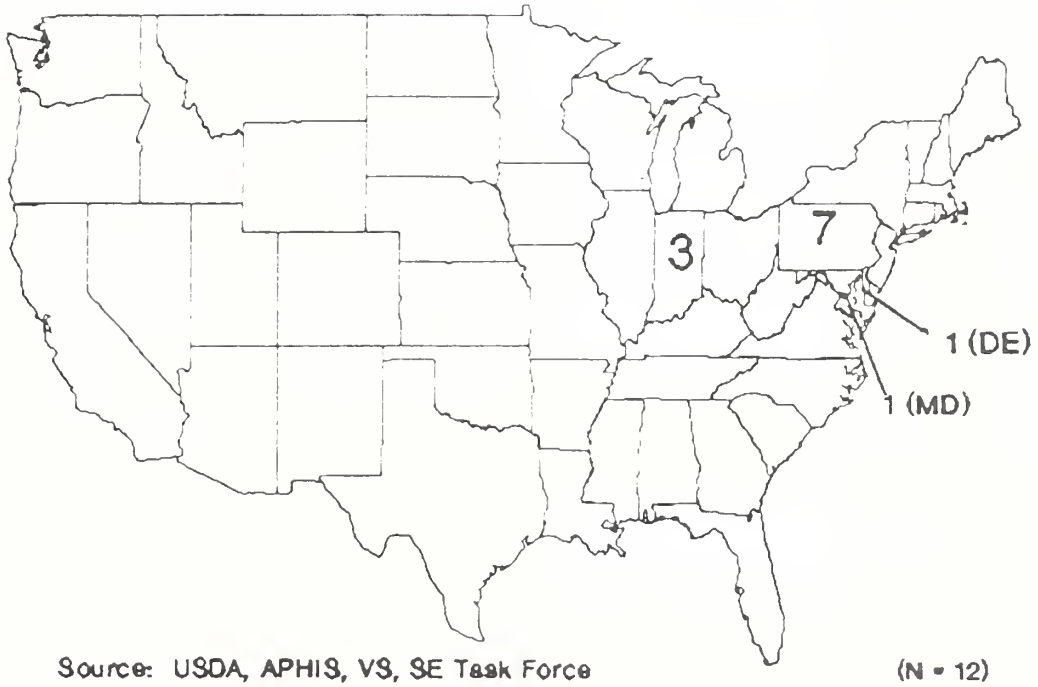
Locations of Commercial Egg Producing Flocks
Implicated as Probable Sources of Hu. SE Outbreaks - 1990



Source: USDA, APHIS, VS, SE Task Force (N = 15)

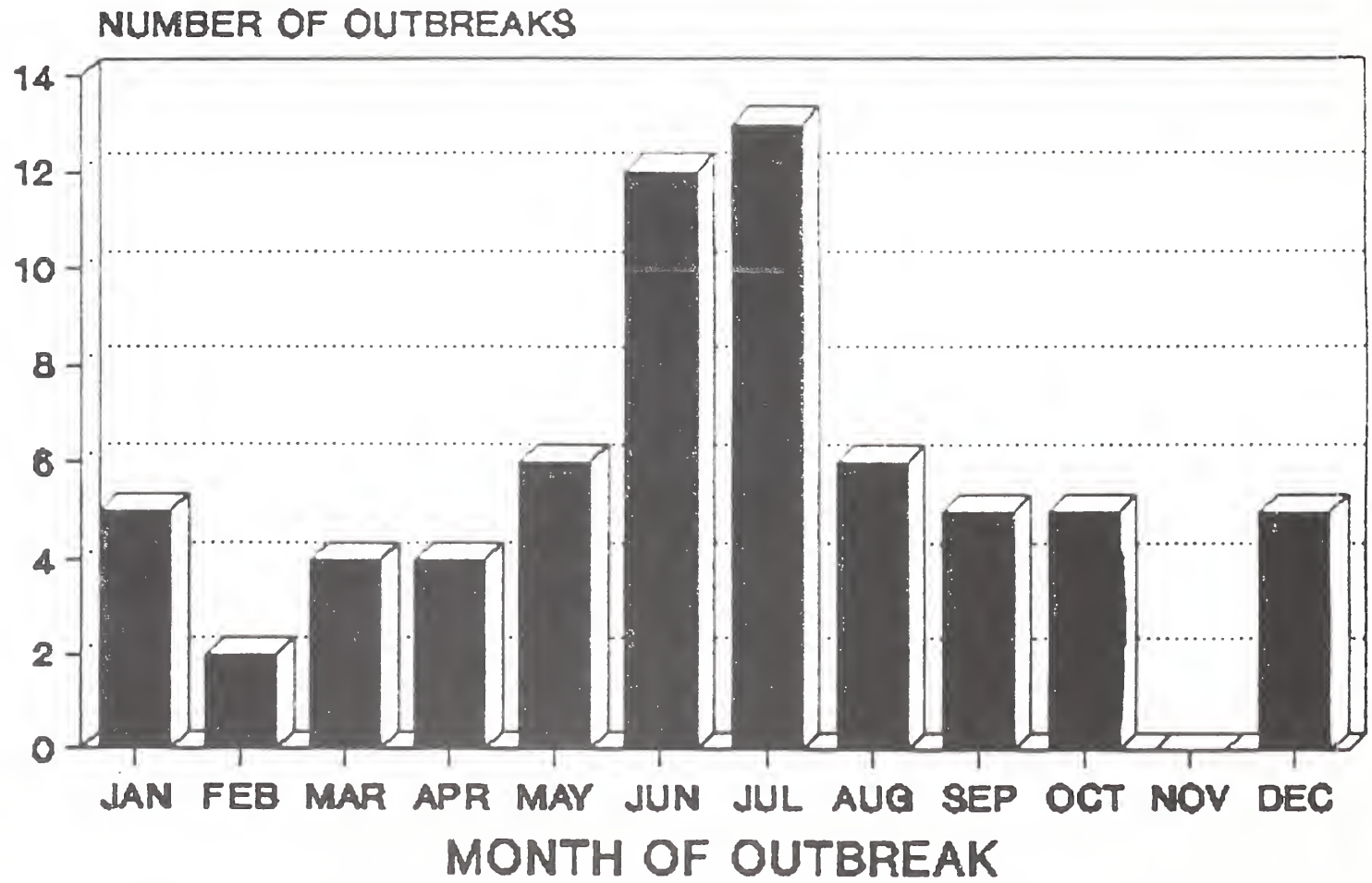
FIGURE 14

Flocks Determined to be SE Infected
by USDA Testing - 1990



Source: USDA, APHIS, VS, SE Task Force (N = 12)

SEASONAL OCCURRENCE
HUMAN SE OUTBREAKS - 1990
(N=67)



Source: USDA, APHIS, SE Task Force 1/18/91

FIGURE 16

SITES OF EGG-IMPLICATED HUMAN SE OUTBREAKS IN 1990

BAKERY	1
SCHOOL	2
FOOD VENDOR (TRUCK)	1
RESTAURANT	13
PICNIC	1
CHRONIC CARE FACILITY/NURSING HOME	2
CAMP	1
HOME	2

FIGURE 17

FOODS IMPLICATED IN SE OUTBREAKS

CAKE - BUTTER CREAM FROSTING	FISH CAKES - MADE WITH EGGS	STUFFING FOR CHICKEN - MADE WITH EGGS
BEARNAISE SAUCE	MILKSHAKES	EGG SANDWICHES
CRABMEAT STUFFING	CHICKEN OSCAR	OMELET
SCRAMBLED EGGS	HOMEMADE ICE CREAM	FRENCH TOAST
EGGS BENEDICT	BREAD PUDDING	BANANA PUDDING
HOLLANDAISE SAUCE		

FIGURE 18

COMPARISON OF HUMAN WITH ENVIRONMENTAL & ORGAN SE PHAGE TYPES

OUTBREAK LOCATION	PT HUMAN	PT ENV	PT ORGAN
SUFFIELD, CT	14B	14B	14B
N.TARRYTOWN, NY	8	3,8,13,13A 23,UNT	8,23
LINTHICUM, MD	8	3,8,23,14B	8
BRISTOL, CT	8	8, 13A	2,8,23,13A
EASTERN, PA	8	NOT SAMPLED	8
NASHVILLE, TE	8	8	NONE
VERSAILLES, KY	8	8, 13A, 23	8
DELMAR, DE	8	8, 23, UNT	8
EATONTOWN, NJ	8, 34	8, 23, UNT	
CHICAGO, IL	8	8, 13A, 23	8
JEFFERSON COUNTY, TN	8	8, 23, 28	8, 23, 28

Source: CDC & APHIS, SETF

FIGURE 19

OTHER SALMONELLA SEROTYPES ISOLATED FROM ENVIRONMENTAL SAMPLES

S. brandenburg
S. anatum
S. cerro
S. kentucky
S. thompson
S. lexington
S. havana
S. heidelberg
S. mbandaka
S. senftenberg
S. thomasville
S. typhimurium
S. braenderup
S. agona
S. amager
S. infantis
S. montevideo
S. worthington
S. johannesburg
S. oranienburg
S. locklease
S. muenster

SOURCE: USDA, APHIS, SETF - 1/18/91

Bovine Spongiform Encephalopathy: A Foreign Disease of Emerging Significance to the United States

by

Arthur U. Davis

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National Veterinary Services Laboratories
Ames, Iowa

Abstract.--Bovine Spongiform Encephalopathy (BSE) is a central nervous system disorder affecting adult cattle and, to date, has only been reported in Great Britain, Ireland, and Oman. In Great Britain, the disease has caused much public debate and media attention over the possibility of transmission of BSE to humans through the food chain. As a result, consumption of British beef has declined over the past several years; and in turn, the British cattle industry has been adversely affected.

The possibility that BSE might be present in the United States was suggested recently as a result of evidence linking the development of transmissible mink encephalopathy in a group of mink to their diet, initially believed to have contained protein supplement derived exclusively from donor cattle. Due to the concern that BSE might be present but undetected in the U.S. cattle population, the U.S. Department of Agriculture, in cooperation with Iowa State University, Ames, Iowa, initiated a survey in June 1990 to look for the disease in U.S. cattle.

The purpose of this presentation is to present a historical background of BSE in England and discuss its present status there. Clinical and pathological features of the disease and details of the cooperative survey for BSE in the United States will also be discussed.

The BSE Crisis in Britain

by

Al Strating

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Abstract.--Bovine Spongiform Encephalopathy (BSE) first appeared in Britain in 1985 and the first laboratory diagnosis was made in November 1986. There were 149 cases diagnosed in 1987 and 1,910 cases reported in 1988 when BSE was declared a reportable disease in Great Britain. As of June 1990, more than 14,000 total cases had been reported on more than 7,000 different farms.

All available information indicates that BSE was caused by feeding bone meal or animal protein supplements produced at rendering plants from scrapie infected sheep carcasses. There is no evidence of natural transmission of BSE from either extended common source epidemic with each affected animal representing an index case. There is no evidence at this time of introduction or spread through any other source.

BSE followed closely on the heels of several other food safety related issues that were widely covered in the British press and caused concern to consumers. These episodes included *Salmonella enteritidis*, lead poisoning, and Listeriosis, and they set the stage for extremely wide and sometimes misleading coverage of BSE as related to human health.

The livestock and rendering industries in Britain have been dramatically affected. Interestingly, human health concerns have focused on the consumption of British beef, with little attention being paid to lamb. Scrapie has been present in the United Kingdom for 250 years. The rendering industry has been very severely affected. Restriction on the use of animal protein in animal feeds has resulted in large unused stockpiles of rendered products.

British animal health officials are optimistic that the BSE problem will subside in several years, as feeding of all rendered animal products to ruminants was stopped in mid-1988.

Environmental Risk Assessment and the Role of the Veterinarian

by

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Section of Epidemiology and Public Health
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Abstract.--Risk assessment is the process by which the potential adverse health effects of environmental contaminants is determined. The process generally involves four basic components: hazard identification, dose-response assessment, exposure assessment, and risk characterization. Traditionally, this has been based on an evaluation of the results of human epidemiologic studies, laboratory animal bioassays, and in vitro experiments. The goal is to use factual information to define human health effects resulting from exposure to hazardous substances in order to determine what is safe or acceptable.

Veterinarians have a unique opportunity to contribute to risk assessment. Animals outside the laboratory can provide crucial information because they are exposed to chemical contaminants under natural conditions often in close proximity to humans. These animals often receive regular physical exams and diagnostic workups to determine the nature of their health related problems. However, epidemiologic studies of domestic animals to link environmental exposures to specific diseases have not been considered in human risk assessment. One such study of the relationship between insecticide exposure, obesity, and transitional cell carcinoma of the bladder in pet dogs will be presented to illustrate how pet animals can serve as sentinels for toxic chemicals in the environment.

Topics of General Interest

A Field Case of Tuberculosis in Llama

by

Marshall O. Pitcher

U.S. Department of Agriculture
Animal and Plant Health Inspection Service/Veterinary Sciences
Maquoketa, Iowa

In 1989 a small herd of llamas were located about 0.5 miles from the Mississippi River on approximately a 30 acre parcel. The owners also had Sika deer, pygmy goats, exotic chickens, guinea pigs, rabbits, Jacob sheep, six or eight dogs, an emu, a couple of peacocks, four or five horses, and two swans. They had no cattle.

On 31 January 1989 a debilitated llama (Mama Llama) with a cria (young llama) at her side was presented by the owners to University of Wisconsin Veterinary Teaching Hospital where it was examined. The following day the llama regressed, becoming comatose. When an attempt was made to feed it via stomach tube, the animal died. An autopsy at the hospital revealed caseated nodules in the right lung and a histopath examination lead to a diagnosis of mycobacteriosis. Unfortunately no fresh tissue from the animal was retrieved for culturing.

An epidemilogical investigation and history of the source of the animals on the premises provided the following information. The llamas were from only one source and the deer were from two sources. The chickens were tested first to find no tuberculin response. The llama and goats were tested by the caudal fold test with bovine PPD tuberculin in March. The only response to the caudal fold test was in three goats on which a comparative cervical test was performed. The results were one reactor, one suspect, and one negative. The reactor goat (Paula) was autopsied and tissue collected to deliver to NVSL for culturing.

The same day of the goat autopsy, the owners were authorized to take one of the llamas (Inka--a daughter of Mama Llama) to the University of Wisconsin since she had developed a painful swelling of the left hock. An examination of the llama was conducted with radiographs from the hock area and the thoracic cavity. The radiograph of the thorax revealed a granulomatous area from which a lung biopsy was performed; the biopsied lung tissue was sent to NVSL for culturing. *M. bovis* was cultured from the biopsied lung tissue and reported on 26 May 1989.

At this time a quarantine was issued on the llamas, goats, and deer. A single cervical test was performed, then read on 3 June 1989, on the llamas, goats, sheep, and sika deer. All were negative except a goat; the goat was autopsied on 30 June 1989.

Inka, the llama, died on 20 June 1989 and was autopsied. Tissue was sent to NVSL for culture. *M. bovis* was cultured and reported on 18 August 1989. Please note the dates on the sequence of events chart (Table) for the results of Inka's tissue culture biopsy (26 May 1989), the date of the second tuberculin test (3 June 1989), and the date when Inka died (20 June 1989).

Dr. Charles Thoen of Iowa State University, a microbiologist in the School of Veterinary Medicine, was informed of our dilemma. On 28 August 1989 Dr. Thoen and I ran the single cervical test at three sites and the comparative cervical test in the left

axillary area on the llamas. Blood was drawn from a couple of the llamas. All tests were negative, including ELISA tests.

In spite of the negative tests, we did not feel tuberculosis had been eliminated from this group of animals. A letter suggesting options was sent from the assistant state veterinarian of Iowa (Dr. Lowell Anderson) and the USDA/APHIS/VS/AVIC (Dr. Bernard Zecha) to the VS central regional director (Dr. Rube Harrington). The options were to depopulate the entire animal and poultry population or to purchase the llamas, goats, and Sika deer for research purposes. Sources of revenue were sought (within USDA/APHIS as well as from private industry) to purchase at least some of these animals for research, but without success.

The owners became anxious for help, and a meeting was arranged on 21 June 1990 for the owners to explain their situation and dilemma to state and federal regulatory veterinarians in Des Moines. As a result of this meeting, a protocol for release from the tuberculosis quarantine on llama and pygmy goats was developed and sent to the owners on 5 October 1990. By this date the Sika deer had been eliminated and the last sheep autopsied. By June 1990 the exotic chickens and many of the pygmy goats had been eliminated. In review, it is important to remember that the original llama (Mama Llama) had three progeny, all females, in this herd. Baby Breath born August 1986, Inka born September 1987, and number 801 born November 1988. Of these, tuberculosis developed only in Inka.

On 23 October 1990 the caudal fold test was read on the 30 goats and one sheep; the caudal fold test and single cervical test was also read on the nine llamas. Nine goats and one sheep responded positively to the caudal fold test. The sheep was autopsied and a comparative cervical test was performed on the nine goats. The results of the tuberculin test on the nine llamas were negative. Blood was drawn from five of the llamas; they were negative on the ELISA test.

In all this drama, some questions arise:

1. Is there a reservoir of tuberculosis (*M. bovis*) in our growing population of llamas in the United States?

2. At our importation quarantine stations are the tools for identifying tuberculosis in llamas or the Camelidae family available or do they need to be perfected?

3. Are llamas implicated in the spreading of tuberculosis or does the relatively short duration of pathological condition in llama make it self-limiting?

4. Must APHIS wait until tuberculosis originating from llamas becomes an epidemic to initiate research on this potentially hazardous disease?

5. History counsels caution in any epidemiological investigation and perhaps we are overlooking the possibility that goats are really the reservoir of *M. bovis* rather than the llamas.

Table. *Sequence of events relating to a field case of tuberculosis in llama.*

31 January 1989	Debilitated llama (Mama Llama) presented to University of Wisconsin Veterinary Teaching Hospital.
1 February 1989	Mama Llama dies and autopsy performed at University of Wisconsin.
16 February 1989	Received a report from AVIC to pursue epidemiological report.
3 March 1989	Read tuberculin test on chickens (44)--all negative.
10 March 1989	Read caudal fold tuberculin test on 21 pygmy goats, 4 sheep, and 3 Sika deer--all negative except 3 goats.
18 March 1989	Read caudal fold tuberculin test on 7 llamas and comparative cervical test on 3 goats. Llamas all negative; 3 goats--1 R, 1 S, and 1 N.
21 March 1989	Autopsied reactor goat (Paula) and took tissue specimens to NVSL. Owners took llama (Inka) to University of Wisconsin due to swollen hock.
22 March 1989	Biopsy of lung of Inka at University of Wisconsin; sent to NVSL.
12 May 1989	Negative culture on goat (Paula) received from NVSL.
26 May 1989	Report from NVSL on lung tissue of Inka sent in by University of Wisconsin that *M. bovis* was isolated.
30 May 1989	Quarantined the premises of the owner to goats, llamas, and deer.
3 June 1989	Read single cervical tuberculin test on 7 llamas, 38 goats, 2 sheep, and 3 Sika deer. All negative except 1 goat; autopsied and tissue to NVSL 30 June 1989.
20 June 1989	Llama (Inka) died and was autopsied; tissue specimens taken to NVSL 21 June 1989.
17 July 1989	T.B. tested a primate in house of owner, along with Dr. Cooper.
18 August 1989	Report from NVSL on tissue from Inka cultured *M. bovis*.
28 August 1989	T.B. tested the llamas with Dr. Charles Thoen from ISU.
30 August 1989	Report from NVSL negative on culture of tissue submitted of goat 30 June 1989.
17 November 1989	Letter to regional AVIC.
21 June 1990	Meeting in Des Moines of regulatory personnel with the owners.
5 October 1990	Protocol developed and sent by state veterinarian to owners for quarters release.

23 October 1990	Read caudal fold test and single cervical test of nine llamas. Also read caudal fold test of 30 goats and a sheep. The sheep and nine goats responded. Autopsied the sheep and performed comparative cervical test on the 9 goats. Llamas were negative. Nine goats with c - c - 4 - N, 1 S, and 4 R. Bled 5 llamas and 7 goats for Dr. Thoen to do ELISA test. Llamas negative to ELISA test.

Mycobacterium avium in a Jersey Cow

by

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Ottawa, Ohio

and Arthur U. Davis

National Veterinary Services Laboratory
Ames, Iowa

The carcass of a Jersey cow was condemned for tuberculosis at a federally inspected slaughter plant in Kentucky. The meat inspector reported extensive calcified lesions in the bronchial and mediastinal lymph glands involving the lungs and pleura. The kidneys had calcified lesions and the eyes had caseous lesions.

The lesions were submitted to the National Veterinary Services Laboratory at Ames, Iowa, for culture and histological examination. Noncaseated or poorly caseated granulomatous lesions were found. Numerous acid-fast bacilli were present within the lesions and a diagnosis of disseminated tuberculosis was made.

The cow was traced, using the backtag number, from the packing plant through a livestock dealer to a farm in west central Ohio. (Interestingly, the packing plant personal, the meat inspector, the livestock dealer, and the farmer all recognized and remembered this cow because she was blind.)

The herd of 114 cattle was tuberculin tested and no reactors were found that suggested this may not be *Mycobacterium bovis*. Subsequently, *Mycobacterium avium* was isolated from the slaughtered cow's tissues.

An epidemiological investigation indicated that the most likely source of *M. avium* infection was from a load of chicken manure that had been dumped in the cow lot about 15 months previously. The manure pile was removed shortly, but this cow was seen standing by the manure pile. The manure came from a flock of aged chickens, a likely source of avian tuberculosis.

The case illustrates the importance of slaughter surveillance, traceback, and epidemiologic investigation in detecting tuberculosis in cattle. It highlights the place of avian tuberculosis as a condition in cattle. Seventeen percent of cattle TB submissions contain *M. avium*. Tuberculosis remains a major cause of condemnation in poultry slaughter plants and in the last two years there has been a 6% increase in human tuberculosis. All are reasons for us to keep an eye on this bug.

Brucella abortus in an Imported Mare

by

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Introduction

Discussion about brucellosis tends to relate to aspects of the disease and its control in cattle. Brucella has been isolated from at least eight other domestic species including horses. Brucella isolations from horses have been reported from Australia, Columbia, Brazil, and the United States (Crawford et al. 1990).

The amount of published information on equine brucellosis is limited. Much of the literature other than review articles is from the first half of this century. The question of transmission from horses to cattle (and vice versa) has often been addressed but not confirmed (Fitch and Dodge 1939; McCaughey and Kerr 1967; Crawford et al. 1990). An infected horse must be considered as a potential source of infection for humans as well.

Brucella infection in horses tends to localize in bursae, muscles, tendons, and joints, rather than in the reproductive tract as in cattle. It causes chronic draining abscesses as in fistulous withers and poll evil more commonly than it causes abortions. Isolation of Brucella from aborted equine fetuses has been reported, however (McNutt and Murray 1924; McCaughey and Kerr 1967; Denny 1973; Carrigan and Cockram 1987).

During the last five years at the National Veterinary Services Laboratory in Ames, Iowa, *Brucella abortus* has been isolated from several but declining numbers of equine samples (Table). Biovar 1 is the most common serotype isolated. This is the common serotype for cattle as well.

Case Report

This report will discuss a case of brucellosis diagnosed in a 9-year-old mare, Luisa, in Ohio. The imported thoroughbred mare developed clinical signs of fistulous withers within 10 days of entering the United States. Luisa had been imported from Argentina into Ohio for playing polo. She had been purchased through an Argentine agent and originally came from a cattle ranch in Argentina.

The mare was quarantined for seven days in Miami, Florida, after entering the United States. She received an atroban treatment and daily temperature monitoring during her stay. She also was negative to dourine, glanders, piroplasmosis, and equine infectious anemia. The trainer did not observe any shoulder swelling when he loaded the horse from the quarantine station.

After a one- to two-day stay at a polo club in Florida, Luisa and six other horses were transported to Ohio. During the trucking, Luisa developed a swelling on her shoulder. The trainer/trucker discovered it during an equipment repair stop. He was concerned about injury caused during the transporting and contacted a Cincinnati area veterinarian. That practitioner ruled out injury as the cause and referred the horse to the trainer's veterinarian in Central Ohio.

The local practitioner drained the abscess and submitted a sample to the Ohio Department of Agriculture diagnostic laboratory for culture and sensitivity and Brucella culture. No growth was found on that culture. The trainer and veterinarian continued to treat the lesion with hydrogen peroxide and mastitis antibiotic tubes. The lesion would heal and reopen. Another sample was submitted six weeks after Luisa began to show clinical signs. This sample grew *Brucella abortus* biovar 1.

Three months after the onset the swelling was minimal and draining was limited to two very small openings. Two months later no external evidence of the infection was evident.

Two serum samples were submitted for brucellosis testing. The first sample, taken three months after Luisa entered the United States, was card (+), standard plate test (-), and rivanol (+1:200). The second sample, seven weeks later, was card (+), standard plate test (+1:25), and rivanol (I1:200).

After the positive *Brucella abortus* diagnosis was made, several precautions were taken to protect other animals and humans. Luisa was quarantined to the horse farm and not permitted to participate in polo. She was housed in a stall alone and not allowed on pasture with other animals. The nearest cattle and the only ones within at least 3.5 miles were two miles from the farm. The trainer was instructed to take extra care while handling and treating Luisa to protect himself and the other horses. The local veterinarian had been splashed in the eye while draining the abscess. His physician recommended oral oxytetracycline treatment for him. Both the veterinarian and the trainer were serologically tested 4.5 months after initial exposure to the lesion. Both results were negative. Neither man exhibited any clinical symptoms of brucellosis. The referring veterinarian from Cincinnati was informed of the positive Brucella results. He felt his exposure in this case had been less than it is during the use of Brucella Strain 19 during his usual practice activities. He had not experienced any symptoms suggestive of brucellosis.

Summary

This case illustrates or highlights several points. The first is that equine brucellosis is usually clinically different from bovine brucellosis. With brucellosis not being a common disease in many parts of the United States, practitioners need to remember to consider brucellosis in their differential diagnoses. Also, practitioners and owners sometimes need to be re-educated about the zoonotic significance of brucellosis. Finally, as brucellosis is eradicated in parts of the United States, owners and animal health professionals can not become complacent about the disease. This imported mare, while passing the required import testing, could have spread brucellosis to a previously free area.

Acknowledgement

Appreciation is extended to Dr. Janet Payeur, National Veterinary Services Laboratory, for information used in preparing this report.

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Table. *Examination for Brucella of horse submissions submitted to NVSL during FY 1985 to FY 1990 (1 August 1990). Information provided by Dr. Janet Payeur.*

Year	# Horses	*Brucella* positives	Biovar 1	Biovar 2	Rough	Strain 19
1985	10	7	6		1	
1986	4	3	3			
1987	8	6	5			1
1988	4	2	1		1	
1989	6	2	1	1		
1990	2	2	2			

Salmonella enteritidis Phage 4 in Aviaries

by

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Abstract.--*Salmonella enteritidis* Phage type 4 (S.E. P-4) is an enteric bacterial pathogen of man and animals. Although it is widespread throughout Europe, Asia, and South America, it is not known to exist in the United States. On 2 August 1990 S.E. P-4 was isolated from a Lilac-crowned Amazon parrot in Nashville, Tennessee. Environmental swab culture tests of the aviary of origin in North Carolina were positive (+) for S.E. P-4. The affected aviary was quarantined and extensive epidemiological tracing and testing was conducted to determine the possible source of the infection and extent of spread. The Action Plan was developed to eliminate the organism from affected aviaries and reduce the risk of spread.

Cooperating Action Plan

The following Action Plan is an agreement between the North Carolina Department of Agriculture, United States Department of Agriculture, and all affected parties to eliminate S.E. Phage Type 4 from aviaries in North Carolina.

Quarantine Release

I. Testing Requirements

All birds in the aviary must have a negative cloacal swab culture test and a negative environmental swab culture test.

If a cloacal swab test positive bird is found, it must be removed and destroyed by Animal Health Officials and the premise must be cleaned and disinfected.

The aviary must be retested negative by the cloacal and environmental swab test no less than seven days following removal of the positive bird and cleaning and disinfecting of the premise.

If a positive environmental culture swab is found and all cloacal swab tests are negative, the premise must be cleaned and disinfected and the entire aviary must be retested negative by the cloacal and environmental swab test no less than seven days following cleaning and disinfecting.

II. Other Considerations

A. Antibiotics shall not be given to birds in quarantine without prior permission from Animal Health Officials.

B. Birds must be identified with individual, unique leg bands. Fledglings will be uniquely identified to the satisfaction of Animal Health Officials.

C. All birds which die during the quarantine period are to be collected and held under refrigeration. All dead birds will be collected from the quarantined premises by an Animal Health Official and sent to an approved veterinary diagnostic laboratory for postmortem examination and bacteria culture.

D. Animal Health Officials are to oversee the disinfection procedures and verify that this has been completed.

III. Movement of Animals Into the Aviary

No movement of birds into aviary is permitted.

IV. Movement of Birds Out of Aviary

No movement of birds out of the aviary is permitted until quarantine release requirements are met except as provided for below:

A. They are fledgling of breeding pairs not known to be positive to either cloacal or environmental tests.

B. They are moved to a hand rearing room that is approved by Animal Health Officials separate and apart from the breeding pairs.

C. They are considered and treated as a sub-unit as follows:
1. Strict Biosecurity must be observed.

2. All fledglings are separated from breeding pairs and moved into the hand rearing room. No fledgling will be considered negative until all roommates have been isolated for no less than seven days and had a negative cloacal swab test and environmental swab test.

3. If all birds and environmental culture tests are negative the quarantine on the fledglings will be released.

4. If a cloacal swab test positive fledgling is found it must be removed and destroyed by Animal Health Officials and the hand rearing room cleaned and disinfected. All birds in the room will be retested no less than seven (7) days following the removal and destruction of the infected bird and cleaning and disinfecting of the hand rearing room.

5. If an environmental positive culture swab is found and all cloacal swab tests are negative, the premise must be cleaned and disinfected and the entire aviary must be retested by the cloacal and environmental swab test no less than seven (7) days following cleaning and disinfecting.

V. No Indemnity Will Be Paid

It is understood however that USDA, APHIS, VS will purchase birds for diagnostic purposes for the following reasons:

A. Any bird in the aviary that is considered to be positive to the cloacal swab test.

B. The diagnostician assigned to the cloacal swabbing project has the option, during the swabbing process, of purchasing for diagnostic purposes any bird deemed necessary.

C. The value of birds purchased for diagnostic purposes will be established based on USDA, APHIS, VS appraised value.

VI. Biological Security

A common sense way of preventing Salmonella (and numerous other avian diseases) is through Biological Security. The following measures are designed to keep disease organisms from entering or spreading through your aviary:

A. Clean and disinfect all vehicles and equipment entering and exiting your premises.

B. Keep out unnecessary visitors and avoid borrowing equipment.

C. Provide coveralls, boots, and foot baths for personnel entering and exiting aviary.

D. Coveralls should be changed and properly laundered.

E. Avoid contact with game birds, migratory water fowl, and rodents (all suspected carriers of avian diseases).

F. Provide only quality, salmonella free food. Salmonella may be carried in water and food. Hands and equipment used in feeding shall be sanitized between each feeding and watering.

G. Thoroughly clean and disinfect premises as Salmonella can reside for months in litter, soil, manure, feathers, dust, and bedding.

H. Disposal of litter manure, feathers, and bedding should be incinerated or disinfected with approved materials.

VII. Public Health

Salmonella can be a serious human health problem particularly in the very young, the elderly, or others who are especially susceptible. Typically, symptoms include diarrhea, fever, abdominal cramps, and vomiting.

Public Health Officials should be contacted for further information.

This Action Plan is entered into with the sole intent of eliminating Salmonella Enteritidis Phage 4 from the aviary.

Changes may be made in the Action Plan at any time by Animal Health Officials to facilitate the control and elimination of S.E. Phage 4 as improved technical data and testing procedures become available.

Preliminary General Swine Farm Report Results for North Carolina

by

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Introduction to the National Animal Health Monitoring System

The idea of a National Surveillance system for Animal Health was proposed by the National Academy of Science in 1974. In its report, "A Nationwide System for Animal Health Surveillance," it set out to establish the epidemiologic mechanisms to detect, evaluate, and measure animal disease with respect to geographical and seasonal occurrence, behavior, and economic importance. The report outlines a nationwide surveillance system designed to: (1) provide continuous surveillance of disease in order to estimate the prevalence and incidence of disease; (2) warn of new emerging diseases; (3) formulate indices to project trends; (4) develop epidemiological data to aid in the control, prevention, and eradication of disease. With these goals in mind, the Animal and Plant Health Inspection Service (APHIS) formally established the National Animal Health Monitoring System (NAHMS) in 1983. The basic process of NAHMS is to collect, analyze, and disseminate information on animal health. Scientific knowledge is expanded primarily by the application of deductive reasoning. NAHMS will provide the large body of data necessary for this process and in this way benefit producers, practitioners, and researchers alike.

The first general survey conducted by NAHMS began in November 1989 with the National Swine Survey. The 1,400 producers randomly selected by the National Agricultural Statistical Service (NASS) from the 18 participating states are each monitored for three months. The first of seven instruments being used for data collection in the National Swine Survey is the General Swine Farm Report (GSFR). This report is completed by the NASS enumerators on their initial visit and addresses some of the basic management practices for the farm. This paper will highlight specific results from the North Carolina GSFR's, as well as address some of the issues and procedures related to the early phases of data analysis.

Introduction to Analysis

The process of analyzing data in general is readily applicable to the analysis of the GSFR's in particular. The goals of analyzing data include: (1) description of the quantitative data, (2) estimation of population parameters, and (3) prediction.

A primary concern is to ensure collection of valid data so that description, estimation, and prediction may be done with precision. Since the raw data collected and entered often contains errors, as well as being incomplete, the first tool used in working with the data is the editing process. The editing process involves several steps including: (1) manual checks of the data, (2) frequency distributions, (3) logic checks, and (4) univariate statistics.

Manual checks of the data, the first step of the editing process, help to identify missing data and/or incomplete data. For this study, several GSFR's missing important

data were considered to be incomplete and not used in the analysis. In checking the data throughout the editing process, one hopes to identify expected results and account for incomplete data and outliers. For example, Table 1 ranks the causes of preweaning mortality in North Carolina. Laid on/mashed pigs was reported to be the leading cause of preweaning mortality by about 50% of the producers; 27% reported it to be the second leading cause of preweaning death. Scours also accounted for a large share of preweaning mortality. The fact that the two leading causes of preweaning mortality were reported to be laid ons and scours is no surprise. Finding an expected result for general descriptive statistics is helpful in the initial validation of the data collection system.

Frequency distributions are helpful for identifying incomplete data, unusual patterns, and outliers. The frequency distribution of several basic management practices can be seen in Table 2. The majority of North Carolina hog operations are farrow-to-finish farms managed by an individual operator who markets directly. The totals within and among frequency distributions should add up. If data supposedly exists for 88 farms and the distribution totals to 81, then the missing data needs to be accounted for.

Not only are frequency distributions helpful in identifying missing data, but unusual patterns can also be spotted. The high percent of producers which market via a cooperative (15%) suggests an area for deeper study. Also, the frequency distribution for record keeping systems used (Table 3) reveals an unusual pattern in that the most frequent response was "other" (46%). This suggests the need for the response categories to be better defined or for additional categories to be created. Notable here is that 41% of the producers use individual record cards for their sows, while 21% of the producers rely on the computer, and 12% kept no records at all.

Finally, the frequency distribution can help identify potential outliers (i.e., those farms at the extreme end of the distribution). In looking at a frequency distribution of farms by size, such as that shown in Graph 1, one may notice (in the raw data) the farm with 4,000 breeding animals. There are many methods for dealing with outliers. This farm needs to be checked to ensure that it is not multiple farms reporting as one. Also note that this graph of size distribution reflects oversampling of larger farms in the National Swine Survey. A weighted distribution would be needed to be truly representative of the North Carolina swine industry.

The third tool in the editing process is logic checks. Hard comparisons can be made in numerous ways. For example, the number of preweaning deaths reported should not exceed the number of pigs born alive. Table 4 gives the average herd size for the different size farms. An average herd size of 530 for medium sized farms defined as having between 100-400 breeding animals is a cause for concern and would lead one to investigate the data, and to edit where appropriate. Such logic checks are an essential part of the validation of data.

Univariate statistics, including measures of central tendency, measures of dispersion, and graphs, aid in the editing process and are also helpful in describing the data. A common measure of central tendency is the mean. Table 5 gives several of the basic production parameters for North Carolina farms. The average number of pigs born alive per litter is 9.18. With an average preweaning mortality of 16%, this brings the average number of pigs weaned per litter to 8.0. Such numbers have little meaning without the proper context. Measures of dispersion such as standard deviation or ranges provide such a context. Table 6, a frequency distribution of the percent of sows on a farm receiving certain farrowing management practices, is summarized by the average percent of sows receiving such practices. While the majority of farms do observe, assist, and give oxytocin to some sows in the farrowing unit (85%, 64%, and 53% of the farms, respectively), the average percentage of sows receiving such treatments is lower (70%, 13%, and 33% of

sows, respectively). This is only for those farms which use such management practices. The "Avg All" row gives the average percent of all sows in the sample receiving the particular management practice. This table illustrates the ability of the mean to cover up underlying patterns of distribution. The average percent of sows receiving the particular management factor for all farms is quite different from the average percent for only those farms performing such practices.

Conclusion

The process of data collection in the first national survey is nearly complete. Several of the above tools have been utilized extensively in the editing process of this enormous data set. Early results from the GSFR alone have already revealed important epidemiological information and exposed some intriguing patterns. The enormous task of analysis lies ahead with the exciting challenge of disseminating the valuable information obtained from the National Swine Survey.

TABLE 1

PREWEANING DEATH RANKED BY CAUSE

LEADING CAUSE	N	%	SECOND LEADING CAUSE	N	%
LAID ON	41	49%	LAID ON	23	27%
SCOURS	17	20%	STARVATION	19	23%
OTHER KNOWN	9	11%	SCOURS	13	15%
STARVATION	6	7%	NONE	11	13%
NONE	5	6%	UNKNOWN	7	8%
UNKNOWN	4	5%	LAMENESS	4	5%
TRAUMA	1	1%	DEFORMITY	3	4%
RESPIRATORY	1	1%	OTHER KNOWN	2	2%
			TRAUMA	1	1%
			NERVOUS	1	1%
			RESPIRATORY	0	0%
	84			84	

TABLE 2

NORTH CAROLINA MANAGEMENT PRACTICES

DECISION MAKER	N	%
INDIVIDUAL OPERATOR	58	72%
PARTNERS	14	17%
HIRED MANAGER	9	11%

MARKETING METHOD	N	%
DIRECTLY	65	80%
COOPERATIVE	12	15%
CONTRACT	4	5%

TYPE OF OPERATION	N	%
FARROW/FINISH	57	70%
FEEDER PIG	23	28%
SEED STOCK	1	1%
GROWER/FINISH	0	0%
	81	TOTAL FARMS

TABLE 3

NUMBER OF PRODUCERS USING RECORDS
by record keeping system

TYPE OF RECORD KEEPING SYSTEM	N	%
OTHER RECORD KEEPING SYSTEM	37	46%
INDIVIDUAL RECORD CARDS	33	41%
POCKET DIARY OR CALENDER	30	37%
MICROCOMPUTER	12	15%
NO RECORDS	10	12%
BUREAU-BASED COMPUTER	6	7%

* other includes notebook, dekalb system, or "in my head"

Graph 1

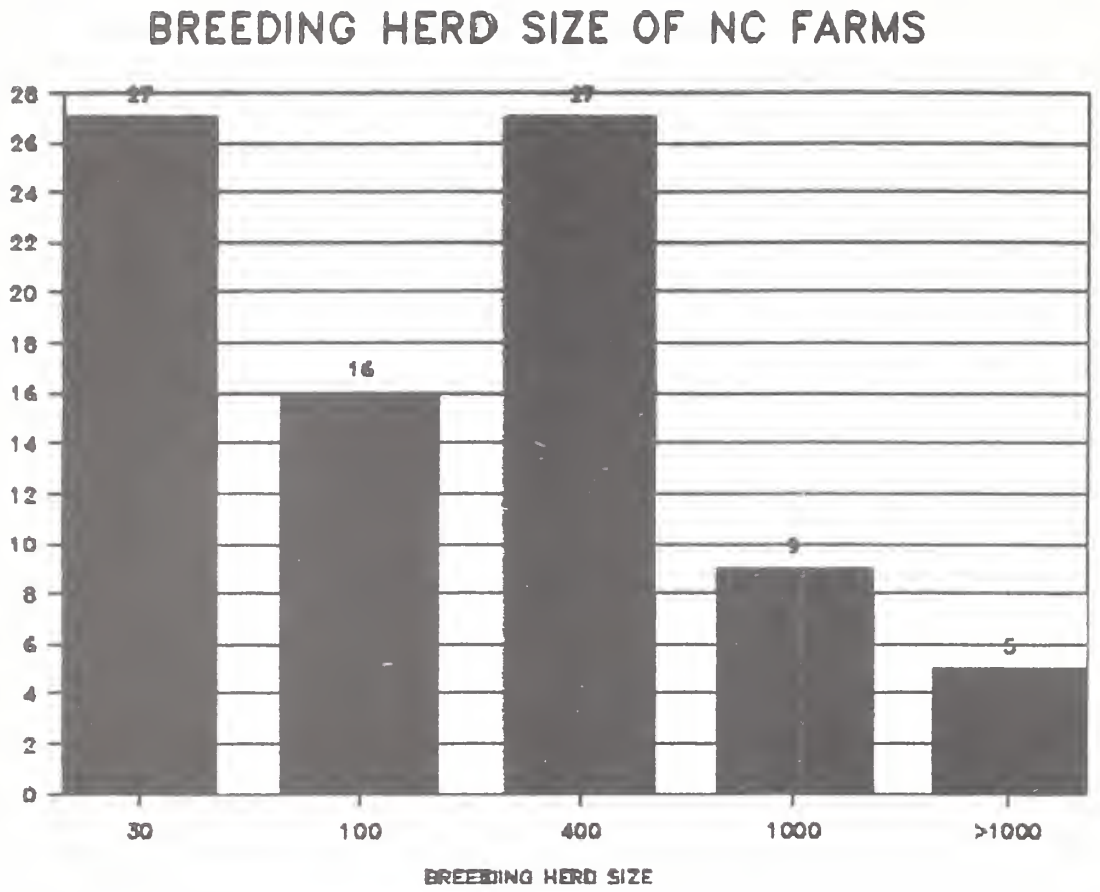
BREEDING HERD SIZE OF NC FARMS
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
27
16
27
9
5
30
100
400
1000
>1000
BREEDING HERD SIZE

TABLE 4

INVENTORY BY NUMBER OF BREEDING ANIMALS

	< 30	30-99	100-399	400-999	>1000	TOTAL
TOTAL SWINE	64.78	367.00	1284.37	3901.78	14646.6	1793.43
TOTAL BREEDING	10.96	60.19	202.59	635.78	1710.6	250.05
% ACTIVE SOWS	0.76	0.84	0.84	0.88	0.93	0.82

TABLE 5

PRODUCTIVITY VALUES FOR NC FARMS

	AVG	STD	RANGE
TOTAL PIGS BORN	10.07	1.86	4.0 - 15.5
PIGS BORN DEAD	0.92	0.71	0 - 4.0
BORN ALIVE (#)	9.18	1.76	2.0 - 15.5
BORN ALIVE (%)	91%		50%- 100%
PREWEANING MORTALITY	16%		0%- 100%
WEANED (%)	84%		0%- 100%
AVG # WEANED	8.00	1.56	0.8 - 9.8

TABLE 6

FREQUENCY OF FARROW MANAGEMENT PRACTICES

QUARTILE	301 WASHED N	%	302 OBSERVED N	%	303 INDUCED N	%	304 ASSISTED N	%	305 OXYTOCIN N	%
25%	56	64%	23	26%	82	93%	82	93%	73	83%
50%	4	5%	20	23%	3	3%	2	2%	4	5%
75%	1	1%	8	9%	3	3%	0	0%	4	5%
100%	27	31%	37	42%	0	0%	4	5%	7	8%
AVG ALL	34.20		58.94		4.66		7.92		16.46	
AVG > 0	88.09		69.58		23.29		12.70		33.31	
	88		88		88		88		88	

QUARTILE	307 SUPPL. MILK N	%	308 CREEP FEED N	%
25%	87	99%	10	11%
50%	0	0%	0	0%
75%	0	0%	3	3%
100%	1	1%	75	85%

Quantifying the Economic Impacts of Swine Diseases

by

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The National Animal Health Monitoring Service has conducted a survey of 1,400 swine operations, estimating characteristics of 95 percent of the U.S. swine population and 84 percent of U.S. swine herd with respect to epidemiologic and economic analyses of health events, risk factors, and management practices. Aside from being the first step in the development of an ongoing swine health event monitoring program, these data will also be used for macro economic estimates of the impacts of major swine diseases.

The objectives of this project are: (1) to estimate national costs of the major swine diseases at the production level, (2) to convert production level impacts into national estimates reflecting cross-commodity supply effects, and (3) to develop indicator series to reflect changes and trends in swine disease events.

Initial analysis will be at the production level. Diseases are classified for their effects on other inputs with regard to their multiplicative or additive impacts. Production level costs include direct expenditures and potential loss from disease occurrence.

Preliminary estimates of production level costs of seven common swine diseases for all hogs in the United States for years 1980-1988 are provided in the Table and illustrated in the Figure. These estimates include incurred animal loss (from deaths or reduced daily gain performance) and expenses for treatments and preventive medicine. In general, the greatest losses during the period were incurred from swine dysentery (hogs less than 101 days of age) and from pneumonia (hogs up to 200 days of age).

The cumulative effects of all major diseases will be calculated and compared against historical estimates of production total morbidity and mortality. Existing macroeconomic models will be modified to generate national estimates of the economic impacts of major swine diseases. Special attention will be paid to account for diseases that may predispose animals to contract other diseases in order to reduce the risk of overstating aggregate estimates of disease costs.

Initially, emphasis will be placed upon quantifying the impacts of disease events upon supply. Ultimately demand factors will be incorporated. It is anticipated that morbidity and mortality data may be combined with other performance information to construct indicator variables which trace the status and trends of animal health events.

Table. *Total costs of animal losses, prevention, and treatment expenses for seven common swine diseases--all hogs in the United States, 1980-1988 (in 1982 dollars).*

	Millions of dollars			
Year	Value of industry: All hogs	Parasites	Swine Dysen.	Pneumonia
1980	6382.821	28.794	127.657	106.267
1981	5998.044	26.592	121.405	99.651
1982	5129.332	22.251	106.008	85.642
1983	5767.810	25.430	116.633	95.132
1984	5509.309	24.268	111.897	91.262
1985	5727.041	25.487	114.985	94.397
1986	4736.104	20.736	97.954	79.752
1987	5056.635	22.042	103.978	84.214
1988	4414.169	19.656	92.839	77.107

	Pseudorabies	Atro. Rhin.	Salmonella	Mange
1980	63.091	31.450	37.783	54.360
1981	59.343	29.588	35.606	51.154
1982	50.996	25.438	30.845	44.019
1983	56.944	28.357	34.024	49.001
1984	54.513	27.150	32.686	46.933
1985	56.499	28.107	33.686	48.553
1986	47.258	23.561	28.724	40.790
1987	50.215	25.024	30.294	43.287
1988	44.701	22.354	27.823	38.807

Factors Affecting Preweaning Morbidity and Mortality

NAHMS Swine Survey: Field Test Results

by

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NAHMS is currently implementing its first national survey. In preparation for this national survey, a field test of the data collection system was conducted on 150 farms in eight states from October 1988 through August 1989. States participating included Virginia, Maryland, Oregon, Georgia, Wisconsin, Alabama, Tennessee, and Illinois.

Participating producers kept prospective records on health events in sows and piglets for a three-month period. Herds were visited by state or federal veterinarians who collected data on management practices and disease occurrences in the farrowing unit. Data available for 2,699 litters include the occurrence of morbidity or mortality events, numbers of piglets born alive, piglet fostering, number of piglets weaned, and the use of health management procedures (e.g., vaccination and deworming).

Factors affecting health and productivity in the farrowing to weaning period were examined. Descriptive statistics were generated for the independent and dependent variables of interest. Subsequently, the association between each of the dependent variables with each of the independent variables was assessed individually with a simple Chi square and odds ratios estimations. Variables associated with the outcomes were then further explored via multiple logistic regression models. Selected results from these descriptive and analytic studies will be discussed. These include descriptions of management, productivity, and health events, as well as associations between management factors and piglet weaning, scours, and crushing.

Using a Stochastic Simulation Model of a Farrow-to-Finish Swine Operation to Evaluate the Economic Cost of Pseudorabies

by

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Quantifying the economic effect of disease in livestock herds continues to be an inexact procedure. Empirical studies, using actual financial data from individual farms, are difficult to extrapolate beyond the study herd. Partial budgeting analysis limits, by design, the amount of information applied to the problem and therefore lacks realism in explaining the economic effect of disease in a highly variable system (e.g., the modern swine production facility).

Using a stochastic simulation model, this study presents economic results from modeling pseudorabies in a 120-sow farrow-to-finish herd over a three-year period. The model is structured as a typical confined herd and disease effects are estimated from a survey of Illinois producers.

The figure illustrates how production variables that influence profitability of the pork producing firm are modeled in this study. Disease effects are added to baseline production effects and the economic results are evaluated.

Table 1 presents the magnitude and duration of pseudorabies induced mortality and abortion. As developed from the survey data, these disease effects are presented for three different groups (i.e., non-affected, moderately affected, and highly affected herds).

Table 2 presents growth effects for the same three groups. The percent of a cohort in each stage of production that experiences growth reduction and the percent that growth is reduced in this group are given. Growth reduction is more severe during, as compared to after, the outbreak period for the H group. However, moderately affected herds actually experience a slight worsening in growth performance following the outbreak period.

Table 3 presents results of the simulated scenarios presented in Tables 1 and 2. All net returns were calculated as total sale revenue minus feed costs. Vaccination practices are incorporated into the scenarios presented in Table 3, but are not explicitly addressed for this presentation. The disease effects portrayed in the MI and HI scenarios actually represent weighted averages of vaccination scenarios, with the omission of vaccine costs. The LI scenario is simply the baseline model's results.

In Table 3, the reduced number of pigs sold (i.e., smaller number of observations) in the MI and HI scenarios is related to the increased mortality and reduced growth of pigs caused by disease effects. The average reduction in net returns per pig from baseline levels is $0.11 and $0.24 for the MI and HI scenarios, respectively. These figures are less than 1% of the mean value of baseline net returns per pig. However, the number of pigs sold differs from the baseline results by 102 and 422 for the MI and HI scenarios, respectively.

Net returns per sow are related to culled sow value. Mean returns per sow actually become less negative with increasing disease levels because of increased premature culling of sows that have aborted following pseudorabies infection. Earlier culling results in less feed investment in a sow whose return above feed costs is declining marginally over time.

Dead pig returns were negative, because of the feed costs invested in these non-salable commodities. Increased pseudorabies disease levels tended to result in smaller average losses per pig because deaths attributable to pseudorabies primarily occur in younger pigs.

The net returns per litter variable captures both mortality and growth effects due to disease. Differences in average net returns per litter from the baseline results are $5.79 and $22.77 for the MI and HI results, respectively. The trend in this variable is towards lower returns and increased variability with increased disease effects, similar to net returns per pig.

Annual net returns were calculated as the sum of net returns per pig, net returns per sow, dead pig returns, and dead sow returns across all individuals that leave the herd each year. This measure of overall profitability is most accurate in defining the average annual cost of pseudorabies for these scenarios. However, because of high variability from year-to-year, the means of the scenarios simulated are not significantly different.

Marketed pigs represent the only source of positive returns for the swine operation. Increased variability in net returns per pig translates into increased uncertainty in cash flow. Increased uncertainty regarding cash flow compromises the capital debt repayment capacity for the firm. For the HI scenario, the change in net returns variability illustrates an additional economic consequence of disease in livestock production.

Calculating the total costs of pseudorabies across all disease levels (including vaccination scenarios not shown here) results in an expected value of pseudorabies costs of $22.66 per sow per year, or $68.00 per sow for the three years of infection simulated.

The benefits of stochastic modeling are twofold: modeling of a standard farrow-to-finish operation controls for herd-to-herd variability due to management and geographic cost/price differences (confounders in empirical studies), while stochasticity provides the realism of normal production variability.

Table 1. *Mean percentage increase in mortality (and abortion) from pseudorabies outbreak and mean outbreak length for each disease strata and stage of swine production.*

	Increase in mortality due to PRV infection			Length of outbreak		
	Disease strata*			Disease strata		
Stage of production	H	M	L	H	M	L
		%			days	
Abortion	14	5	0	69	33	0
Sows/gilts	2	2	0	69	33	0
Lactation	45	18	0	69	33	0
Nursery	12	1	0	72	8	0
Grow Stage 1	7	0	0	78	0	0
Grow Stage 2	1	0	0	90	0	0
Finisher	1	0	0	90	0	0

* H=highly affected herds, M=moderately affected herds, L=Low affected (non-affected) herds.

Table 2. *Mean percent of pigs exhibiting growth reduction and average magnitude of growth reduction because of pseudorabies for each stage of swine production in the three disease strata.*

	Percent of pigs affected (Percent growth rate reduction)					
	During outbreak*			After outbreak		
Stage of production	H	M	L	H	M	L
		%			%	
Nursery	56.0	9.0	0	21.0	3.0	
	(17.5)	(2.5)	(0)	(2.5)	(2.5)	
Grow Stage 1	52.0	2.0	0	13.0	10.0	
	(17.5)	(2.5)	(0)	(2.5)	(2.5)	
Grow Stage 2	40.0	2.0	0	19.0	5.0	
	(12.5)	(2.5)	(0)	(7.5)	(2.5)	
Finisher	36.0	5.0	0	13.0	5.0	
	(12.5)	(2.5)	(0)	(7.5)	(2.5)	

* H=highly affected herds, M=moderately affected herds, L=Low affected herds

Table 3. *Net returns variables resulting from three-year simulation of LI (baseline production), MI, and HI pseudorabies disease scenarios.*

VARIABLE	SCENARIOS*		
	LI	MI	HI
Net returns/pig			
Mean**	54.90	54.79	54.66[b]
S.D.	5.86	5.91	6.12
No. of observations	5,248.00	5,146.00	4,826.00
Net returns/sow			
Mean	-97.51	-95.65	-93.54
S.D.	83.18	82.69	84.03
No. of observations	261.00	263.00	264.00
Net returns/dead pigs			
Mean	-1.99	-1.92	-1.94
S.D.	6.48	6.32	6.24
No. of observations	2,014.00	2,069.00	2,271.00
Net returns/litter			
Mean	400.30	394.51	377.53[a]
S.D.	89.80	91.70	108.12
No. of observations	755.00	752.00	739.00
Annual net returns			
Mean	86,217.00	84,230.00	78,167.00
S.D.	5,566.00	5,309.00	11,570.00
No. of observations	3.00	3.00	3.00

* LI=low impact (baseline), MI=moderate impact, and HI=high impact.
**Mean net returns are in dollars.
[a]Differs significantly from LI scenario result at 5% level.
[b]Differs significantly from LI scenario result at 10% level.

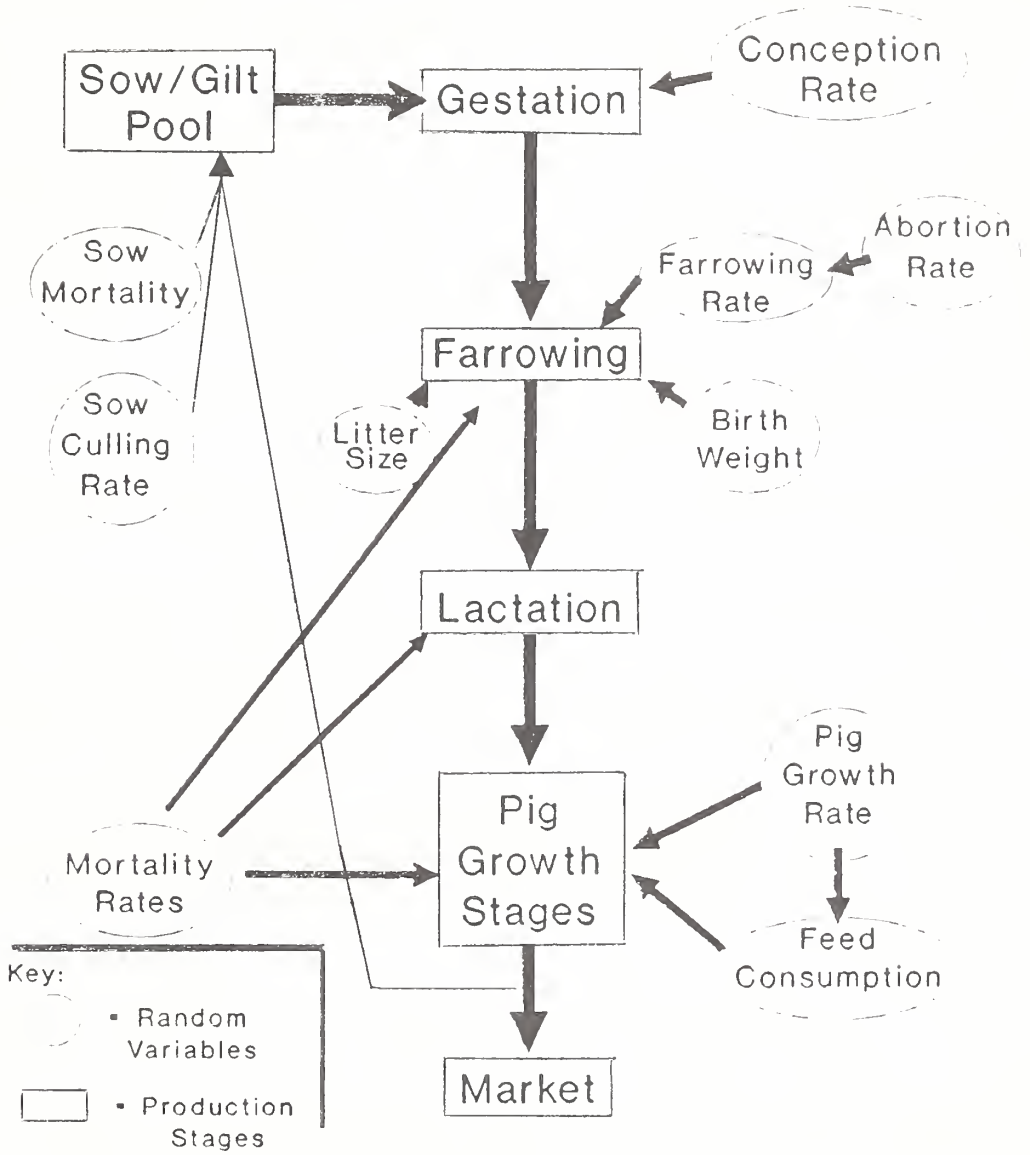

Figure 1. Influence diagram of simulation model.

NAHMS National Swine Survey: Analysis of First and Second Quarter General Swine Farm Reports

by

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The National Animal Health Monitoring System (NAHMS) launched its first national study in December 1989. The National Swine Survey (NSS) focuses on the health and productivity of farrowing sows and their litters in 18 states. Information obtained from approximately 1,200 producers includes management practices; swine disease history; variable costs; and prospective monitoring of health events, treatments, and losses among sows and piglets up to weaning.

The General Swine Farm Report (GSFR) is the first questionnaire administered to producers as part of the NSS. It provides a snapshot of the organizational structure and management practices used on a cross section of U.S. swine farms. After completing the questionnaire during a personal interview, a producer may choose to participate in the three-month monitoring phase of the survey.

The first two quarters of the NSS are completed. Selected variables from the first and second quarter GSFR's were analyzed to determine if significant differences existed between NSS participants and nonparticipants. In addition, participant responses from each quarter were compared.

A total of 464 GSFR's were completed in Quarter 1. Twenty-eight producers from Quarter 1 were not selected or ineligible to participate (no sows to farrow during the scheduled monitoring period), 15 producers were not contacted, 173 refused to participate, and 28 producers dropped out, leaving 220 participants (47.4%).

A GSFR was completed by 359 producers in Quarter 2. Of these, 18 producers were not selected or ineligible, 9 were not contacted, 146 refused, and 14 dropped out. The Quarter 2 participation rate of 47.9% (172 producers) was similar to that of Quarter 1.

Not having enough time and poor time of the year were cited by producers in each quarter as reasons for not wanting to participate in the three-month monitoring phase. Together, these two reasons accounted for 59.5% and 61.6% of the refusals in the first and second quarter, respectively.

The majority of both participants and nonparticipants (includes refusals, nonselects, ineligibles, noncontacts, dropouts) were farrow-to-finish operators. Less than 21% of the producers completing a GSFR were feeder pig operators. Breeding stock plus grow/finish producers constituted less than 3% of the sample. No association was observed between operation type and participation status in either quarter, nor was any relationship seen between participants in each quarter.

Most producers, regardless of participation status and quarter, expected fewer than 100 sows to farrow in an upcoming three-month period. About one-quarter of Quarter 1 participants and 18.6% of Quarter 2 participants expected 100 or more sows to farrow (P=0.14).

Pocket diaries or calendars were the most popular type of record keeping system used by all producers (Fig. 1). Both in Quarter 1 and Quarter 2, participants were significantly more likely to keep record cards for individual members of the breeding herd (P=.001). There were no differences between Quarter 1 and Quarter 2 participant use of pocket diaries or record cards. About 29% of Quarter 2 participants and 16.8% of Quarter 1 participants reported use of a PC-based system (P=.004).

No significant relationship existed between average total pigs born or pigs born alive per litter in the last three months and participation status in either quarter (Fig. 2). Participants in Quarter 2 reported slightly more total pigs born per litter and pigs born alive per litter than Quarter 1 participants but these differences were not statistically significant.

In each quarter, participants weaned their pigs at a significantly lower age than nonparticipants (P<.05, Table 1). In the first quarter only, participants weaned pigs at a lighter weight (P<.05). These weaning results are based on events from the previous three months. Even though Quarter 1 participants weaned pigs at a slightly younger age and weight than Quarter 2 participants, the differences were not significant. Nonparticipants in each quarter reported a slightly higher average%age of pigs weaned than participants.

More participants than nonparticipants in each quarter washed sows prior to farrowing; however, this difference was significant only in Quarter 1 (46.8% vs. 35.7%, P<.05). Six% more of the Quarter 2 participants washed sows, but this was not significantly different from the%age of Quarter 1 participants who washed. On the average in both quarters, about three-quarters of the sows on a given farm were washed among participants and nonparticipants who reported washing.

About half of the producers in each quarter reported laid on, or crushing by the sow, as the leading cause of death in preweaned piglets during the past three months. A slightly larger%age of Quarter 2 participants than Quarter 1 participants said that laid on was the primary cause (51.2% vs. 47.2%), but this difference was not significant (P=.44). Both participants and nonparticipants in each quarter claimed that laid on accounted for about 70% of all deaths in preweaned piglets. Scours was also an important cause of baby pig death, with 24.5% of Quarter 1 participants and 18.5% of Quarter 2 participants citing it as the primary cause (P=.15).

There was no significant association between participation status and prior knowledge of NAHMS in either quarter. Less than one-fourth of both participants and nonparticipants had heard of NAHMS. Swine publications were the most frequent knowledge source for those who knew about NAHMS (Table 2). In Quarter 2, participants were 1.5 times more likely to have read about NAHMS in a publication than nonparticipants (P=.06). Ten% more of Quarter 2 participants had read about NAHMS in a pork magazine than Quarter 1 participants (P=.37). Producer meetings were also an important source of NAHMS information. Participants in each quarter were three times more likely to have heard about NAHMS at a producer meeting than nonparticipants, but this difference was significant only in Quarter 1 (P<.05).

In summary, there was no association between participation status and operation type or size (based on expected farrowings) in either quarter. Participants, when compared to nonparticipants, employed a few management practices that are considered more

progressive, i.e., use of record cards, younger weaning age, and sow washing. However, the number of management practices showing a significant difference between participants and nonparticipants is relatively few, and they generally did not hold for both quarters. In addition, preliminary analysis of the remaining GSFR variables show no differences between the two respondent groups. It's unlikely that participants are better producers. Participants also didn't have healthier piglets, as the weaning%age was actually higher among nonparticipants in each quarter.

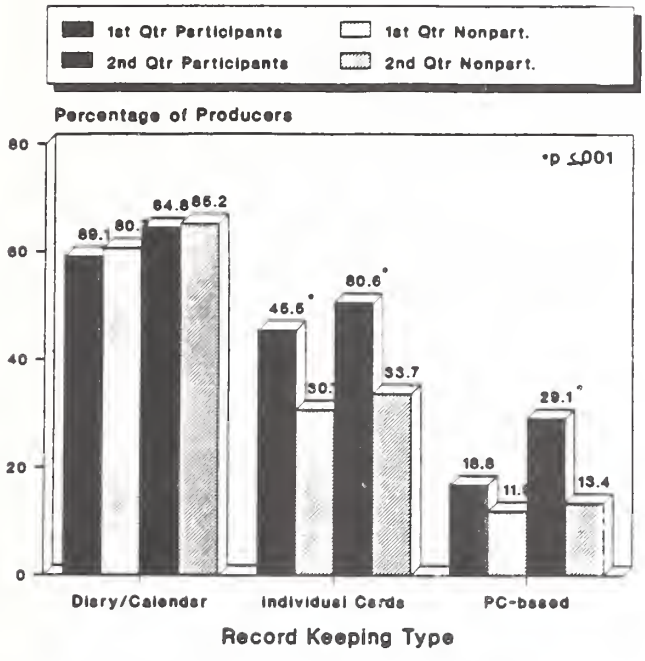
The only variable where a significant difference was observed between Quarter 1 and Quarter 2 participants was in the use of PC-based record keeping systems. This observation is unlikely to indicate a seasonal effect, but may reflect the growing use of on-farm computers as a management tool.

Participants in Quarter 2 were more likely to have heard about NAHMS prior to completing the GSFR, but the increase over Quarter 1 was not statistically significant. The announcements about the National Swine Survey in major pork magazines in October and November 1989, which preceded the interview of Quarter 2 producers, may have been a contributing factor. NAHMS should continue to target information about the survey to producer publications and producer meetings to enhance participation in future quarters.

This analysis suggests that any refusal effect in the Quarter 1 or Quarter 2 GSFR data is minimal. Producers were not more likely to participate if they had a small operation, practiced good management, or had heard of NAHMS. The next step in this analysis is to compare the participant GSFR data with results from the prospective monitoring phase.

FIGURE 1

Record Keeping Systems Used
NAHMS National Swine Survey

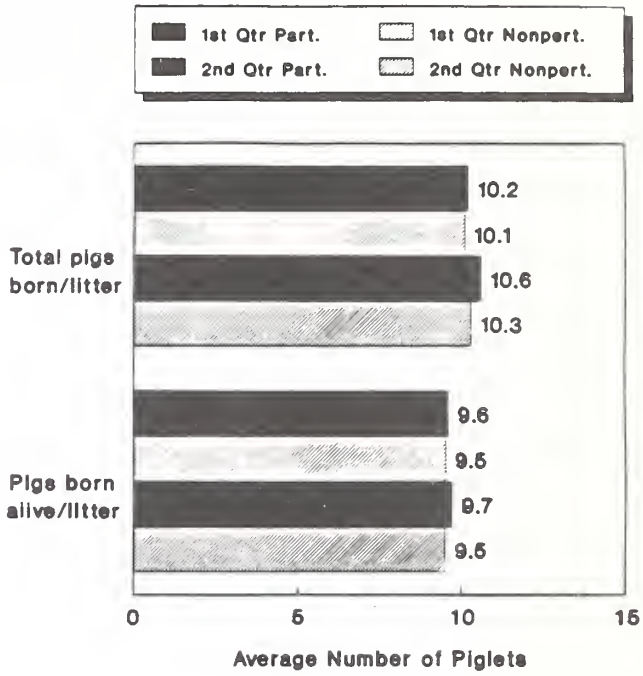


Respondents may have used >1 record keeping system.

USDA:APHIS:VS

FIGURE 2

Sow & Gilt Productivity
NAHMS National Swine Survey



USDA:APHIS:VS

TABLE 1

Weaning Results
NAHMS National Swine Survey

	Quarter 1		Quarter 2	
Result	Participants	Nonpart.	Participants	Nonpart.
Weaning age (days)	30.3	33.0**	31.2	33.7*
Weaning weight (lbs.)	20.5	22.6*	20.6	22.3
Weaning %	88.4	89.4	87.6	89.1

*p = <.05
**p = .001

USDA:APHIS:VS

TABLE 2

Source of NAHMS Knowledge
NAHMS National Swine Survey

	Quarter 1		Quarter 2	
	% of Producers Identifying Source			
Source	Participants	Nonpart.	Participants	Nonpart.
Swine publication	51.4	57.6	61.5	40.0
Producer Mtg.	29.7	8.9*	23.1	5.7
Producer Newsletter	18.9	17.8	18.0	14.3
Extension	10.8	17.8	10.3	22.9
Local Vet	10.8	2.2	5.1	2.9
Feed/Animal Health Supplier	5.4	6.7	0.0	5.7
Neighbor	5.4	0.0	2.6	8.6
Newspaper	2.7	0.0	7.7	8.6
Other	21.6	24.4	15.4	17.1
Total # of Producers	37	45	39	35

*p < .05

Respondents may have identified >1 source.

USDA:APHIS:VS

Comparative Economic Performance and Evaluation of Three Sizes of Swine Operations

by

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In March 1989, the National Animal Health Monitoring System began an economics field test survey in four states. These states--Alabama, Illinois, Tennessee, and Wisconsin--were the first states of a larger comprehensive swine survey to have economic questions included. The field test survey of these four states was concluded in August 1989.

A project was designed to utilize the collected economic data (as well as management data) to compare and evaluate different sizes of swine operations. This became a particularly interesting study in light of the extensive and ongoing controversy surrounding the plight of the small family farm and projections of increasingly fewer and more efficient large farms. It should be stated that this controversy and these projections are not within the scope, nor are they a concern, of this study. The study and the data will simply point out areas of relative inefficiencies and thereby make them obvious as possible areas for improving economic performance for all sizes of swine operations.

Early on, it was decided that a computer budget program developed at the University of Guelph in Ontario, Canada, for farrow-to-finish swine operations would be used as a tool to manipulate and analyze the economic and performance variables for the different sizes of swine operations. (This program required that feed values be stated in kilograms and that for lack of data fixed costs be intentionally omitted.)

It was necessary to divide the four states into size groups. The states and their corresponding numbers of farms were: Alabama, 14; Illinois, 10; Tennessee, 16; and Wisconsin, 14. Farms were classified as large, medium, or small based on the number of breeding age sows and gilts maintained. Large farms were designated as those having 85 females or more while medium-sized farms would have 36 to 84 females and small farms would have 35 or less (Fig. 1). Use of this designation gave an equal distribution of 18 farms in each size category. Small, medium, and large farms had respective averages of 23, 57, and 203 females. The average large farm had 182 sows, 21 gilts, and 10 boars; the average medium farm had 51 sows, 6 gilts, and 3 boars; and the average small farm had 21 sows, 2 gilts, and 1 boar. These average numbers were subsequently used as herd size variables in the computer budget.

The next variable to be taken from the data for the budget was "pigs born alive per litter." For this variable, large, medium, and small farms had respective averages of 9.88 pigs, 9.32 pigs, and 9.16 pigs. A possible explanation for the better performance reported for the larger operations might be that more help was available round-the-clock in the farrowing houses. A second variable which greatly affected future available numbers of market pigs was "percent deaths birth to weaning." The respective average values (large to small farms) were 12.04%, 14.59%, and 16.59% (Fig. 2). Here, the better performance by larger operations might be explained by the use of better facilities or closer monitoring of the baby pigs. Disease and other health-related problems might also be a factor.

Small farms tended to use less feed per head for adult animals but more for growing animals than did the other size farms (Table 1A, 1B). These tendencies of small farms to feed more to growing animals would be favorable if the amounts were optimum for maximum conversion, but they were generally above normal values and thus may indicate feed waste. Additionally, performance by breeding animals might be hindered if feed amounts are inadequate. Medium-sized farms appear to feed inadequate amounts to feeders (2.06 kg/hd/day) when compared with a normal value of 2.40 kg/hd/day.

The "time birth to weaning" variable was about right for the large operations but prolonged for medium and small operations. This could have decreased "litters per sow per year" for medium and small farms and thus decreased efficiency. In spite of these prolonged "birth to weaning" times, all farm categories (large, medium, and small) had similar "total days birth to market" and "market weights" (Table 2). This was due to shortening of the number of days as weaners and feeders when "birth to weaning" was longer than normal as was the case with small and medium farms.

Feed costs were higher for nearly all rations for nearly all pig types for the small-sized farms (Table 3A, 3B). This was probably to be expected because volume purchases by larger users of any commodity are generally less expensive. Also small operations probably purchased more sacked, rather than bulk, feed which is generally more expensive.

Service costs were higher on a per female maintained basis for small farms, due mostly to the large amount of money spent by small producers on consultant fees (Fig. 3, 4). This high amount spent by small producers may have been due to a perceived or real lack of expertise in swine husbandry and management by those who raised hogs as a sideline to their main occupation. It is also interesting to note that operators of medium-sized farms spent the least on consultants, possibly because they may have felt they could not afford such services. Large farms, on the other hand, spent more than medium but much less than small farms and likely justified the costs by spreading them over larger populations.

Labor costs were highest for small and medium farms and nearly twice as high on a per female basis as large farms (Fig. 5). This most likely was due to greater efficiency of larger farms gained through the use of automation and better facilities. Better utilization of manpower may also have been a factor.

Marketing and hauling costs were highest for small farms and regressed to lowest for large farms (Fig. 6).

The variable listed as "price of market pigs" ($.95/kg) was compiled from the USDA Economic Research Services's publication "Agricultural Outlook" and was the computed average price of market pigs for the survey months of March - August 1989. This price received was assumed to be constant for all sizes of farms.

By putting into the budgets the computed variables from the field test data, the large operations performed closely to the average (normal values) farm losing only $164.53 per female (Fig. 7, Budget 2), which was actually better than the average farm's loss of $173.79 (Fig. 8, Budget 1). However, medium farms lost $265.73 (Fig. 9, Budget 3) per female and small farms lost $486.10 (Fig. 10, Budget 4) per female. The main reason that all operations showed losses was the high feed costs relative to the market price received during the study period. By putting into the budgets the value of 15.11 cents per kg, which was the 1988 average feed cost of all diets listed in the 1988 Iowa State University Swine Enterprise Summary of 295 farms, both the average and large farms become profitable (Fig. 11, Budget 5).

In summary, the results of this study showed that the larger swine operations are operating more efficiently, possibly due to economies of scale and different management practices. However, this would be a generalized statement since fixed costs are unknown and were not addressed. In all categories, debt load would have much to do with profitability and economic survival. This study has, nevertheless, illuminated many areas that all swine producers (and particularly small producers) could improve upon. The most glaring areas for improvement would be: (1) pigs born alive per litter; (2) percent death birth->weaning; (3) optimum feed amounts; (4) shorter birth->weaning time; (5) lower feed costs; and (6) lower service, labor, and marketing costs (to the point of maximum efficiency). Some of the possible benefits of improvements in these areas are illustrated in the Spring 1990 USDA/APHIS/Veterinary Services publication "Animal Health Insight." An article in the publication, titled "Physical Performance Measures and Economic Returns" by Kevin D. Walker and J. Kliebenstein, makes estimates of increased returns over operating expenses for improvements in some of the six areas addressed in this study (Table 4). A 5 percent increase in "pigs born alive per litter" translates to an estimated increased return of $41/sow/year. Likewise, a decrease of 5 percent in purchased feed prices would bring about an estimated increased return of $49/sow/year. And a 1 percent reduction in "deaths birth->weaning" would result in an estimated increased return of $10/sow/year.

Regardless of the size of the operation, the production variables illustrated by the collected data and this study can be improved and gains can be made toward greater profitability.

NAHMS Swine Field Test

Operations Monitored

Alabama, Illinois, Tennessee, Wisconsin

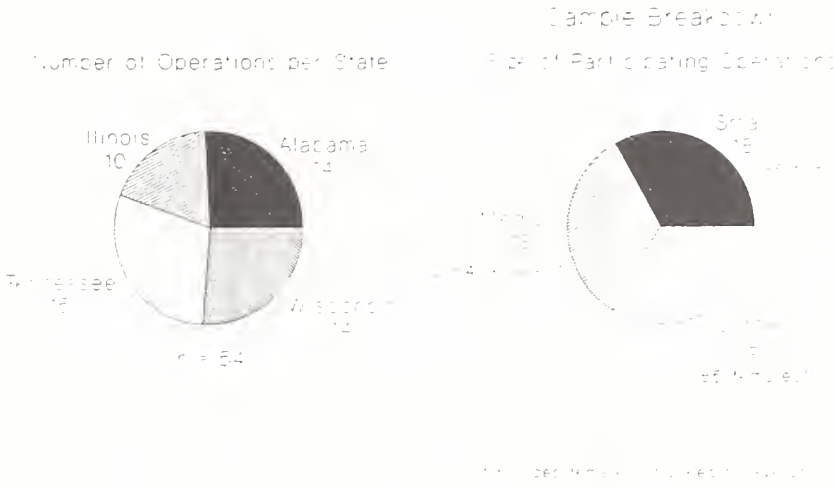


Figure 1

NAHMS Swine Field Test

Selected Performance Measures*

Farms Monitored = 54

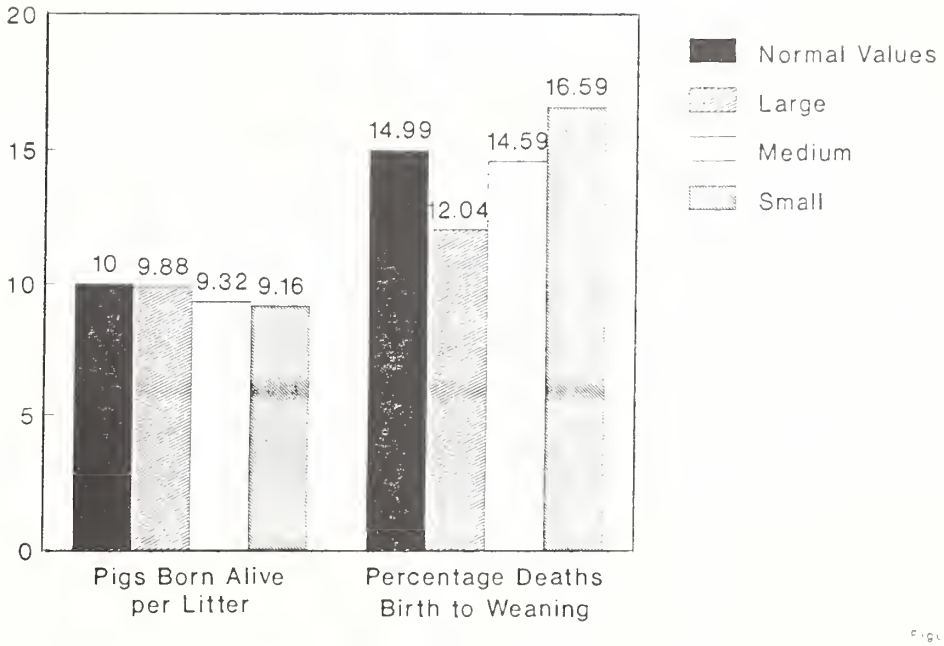


Figure 2

NAHMS National Swine Survey

Feed Amounts Comparisons* Adult Animals

Pig Type	Large Farms (≥85 females) Kg/head/year	Medium Farms (36-84 females) Kg/head/year	Small Farms (≤35 females) Kg/head/year	NAHMS Presurvey Average Kg/head/year
Boar	870.16	888.89	685.38	996.46
Gestating and Dry Sows	771.98	901.03	771.73	785.10
Nursing Sows	249.54	293.91	204.23	243.08

*Includes results from Alabama, Illinois, Tennessee, and Wisconsin.

Table 1A

NAHMS National Swine Survey

Feed Amounts Comparisons* GrowingAnimals

Pig Type	Large Farms (≥85 females) Kg/head/day	Medium Farms (36-84 females) Kg/head/day	Small Farms (≤35 females) Kg/head/day	NAHMS Presurvey Average Kg/head/day
Nursing Piglets	.21	.21	.28	.68
Nursery Pigs	.77	.85	.84	.68
Feeder Pigs	2.32	2.06	2.66	2.40

*Includes results from Alabama, Illinois, Tennessee, and Wisconsin.

Table 1B

NAHMS National Swine Survey

Selected Performance Measures*

(n = 54)

Farm Size	Time Birth-Weaning (days)	Weaning Wt. (Kg)	Time as Weaners (days)	Feeder Wt. (Kg)	Time as Feeders (days)	Market Weight (Kg)	Total Days to Market Weight	Average Daily Gain Birth-Market (Kg/day)
Average	28.00	7.00	43	22.27	111	108.63	182	.5969
Large (≥85 females)	28.89	7.35	30.35	22.30	116.09	108.09	175.33	.6165
Medium (36-84 females)	32.37	8.59	27.98	20.88	108.36	100.75	168.71	.5972
Small (≤35 females)	44.00	11.67	21.53	23.79	112.90	107.33	178.43	.6015

*Includes results from Alabama, Illinois, Tennessee, and Wisconsin.

NAHMS National Swine Survey

Feed Costs Comparisons* Adult Animals

Pig Type	Large Farms (≥85 females) Cents/Kg	Medium Farms (36-84 females) Cents/Kg	Small Farms (≤35 females) Cents/Kg
Boar	18.43	16.32	27.78
Gestating and Dry Sows	17.96	16.26	24.99
Nursing Sows	18.84	17.27	23.28

*Includes results from Alabama, Illinois, Tennessee, and Wisconsin.

Table 3A

NAHMS National Swine Survey

Feed Costs Comparisons* GrowingAnimals

Pig Type	Large Farms (≥85 females) Cents/Kg	Medium Farms (36-84 females) Cents/Kg	Small Farms (≤35 females) Cents/Kg
Nursing Piglets	59.80	50.72	38.35
Nursery Pigs	32.62	30.72	28.19
Feeder Pigs	18.03	17.21	18.76

*Includes results from Alabama, Illinois, Tennessee, and Wisconsin.

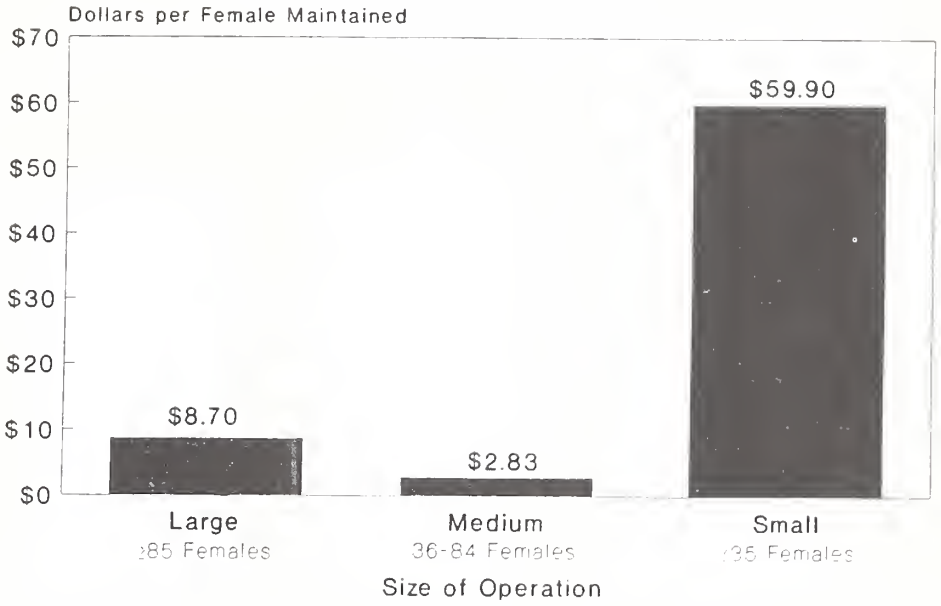
Table 3B

NAHMS Swine Field Test

Consultant Fees Comparison*

Number of Operations = 54

Figure 3



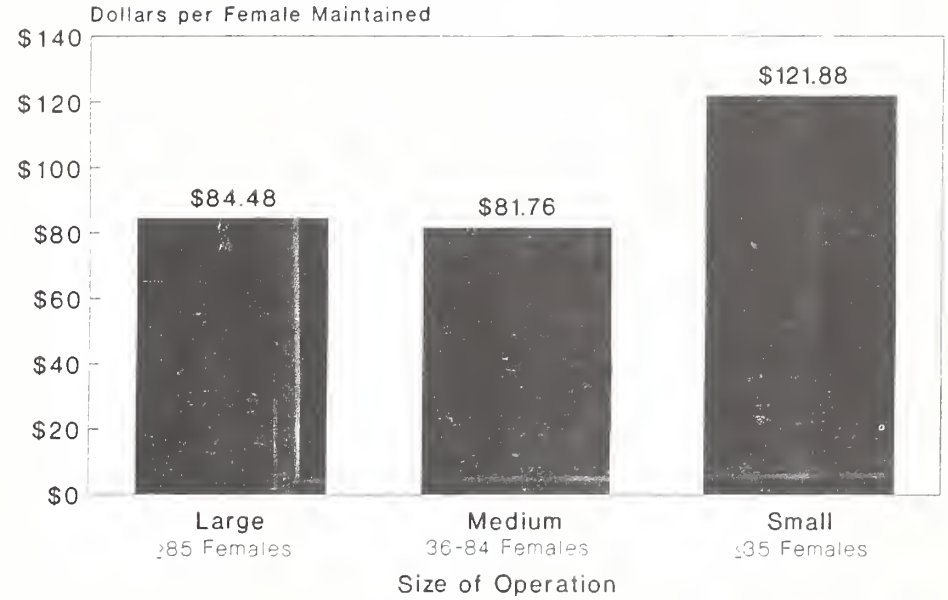
*Results from Alabama, Illinois, Tennessee, and Wisconsin

NAHMS Swine Field Test

Service Costs Comparison*

Number of Operations = 54

Figure 4



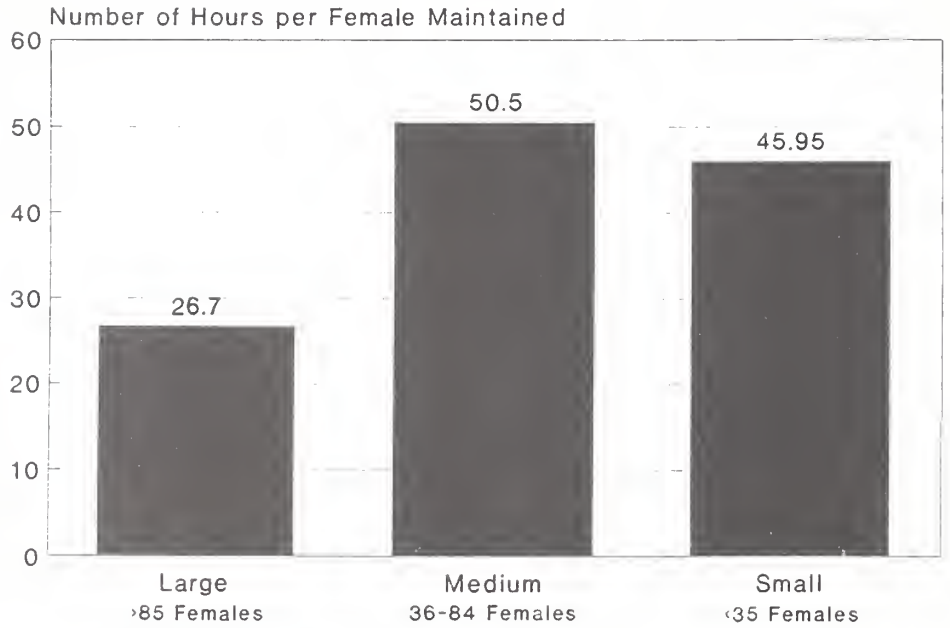
*Results from Alabama, Illinois, Tennessee, and Wisconsin. Includes all variable costs except labor, marketing, and hauling.

Figure 5

NAHMS Swine Field Test

Labor Input Comparisons*

Number of Operations = 54



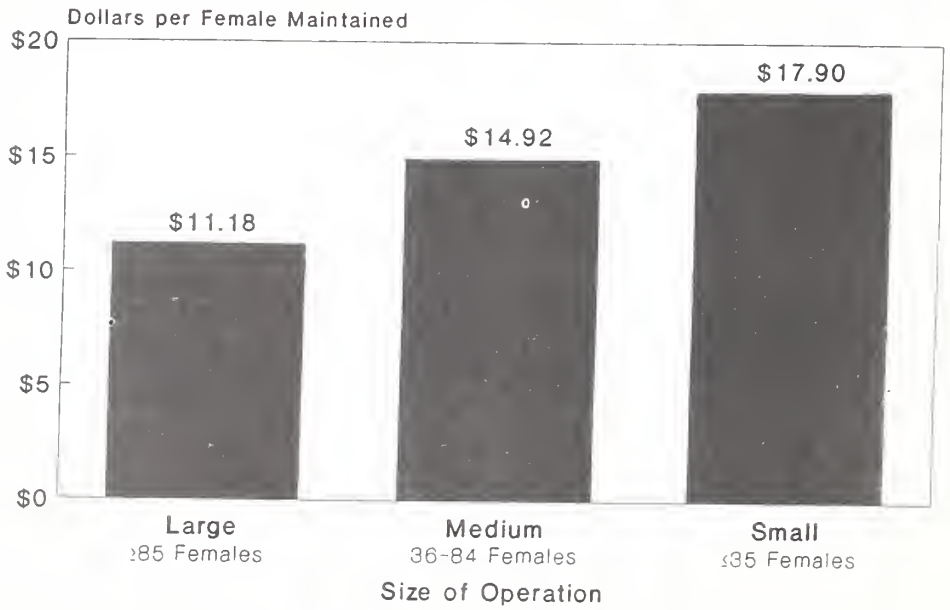
*Results from Alabama, Illinois, Tennessee, and Wisconsin.

Figure 6

NAHMS Swine Field Test

Marketing and Hauling Costs Comparison*

Number of Operations = 54



*Results from Alabama, Illinois, Tennessee, and Wisconsin

Figure 7
BUDGET #2

LARGE FARM

(GREATER THAN OR = TO 85 HD)

AVG = 203 FEMALES (182 SOWS & 21 GILTS) FOR 18 FARMS

A: HERD PARAMETERS
(Physical inputs)

1.	Sows	182.00		
2.	Gilts	21.00		
3.	Boars	10.00		
4.	Replacement % sows	38.33		
5.	Replacement % boars	43.33		
6.	Litters/sow/year	1.82		
7.	Pigs born alive/litter	9.80		
8.	% death birth->weaning	12.04%		
9.	weaners	3.33%		
10.	feeders	1.00%		
11.	breeding stock	1.67%		
			Feed	
12.	Feed boar (kg/yr)			870.16
13.	dry sow (kg/yr)			771.98
14.	nursing sow (kg/yr)			249.54
15.	Creep/litter(kg/day)			0.21
16.	Starter/pig (kg/day)			0.77
17.	Feeder/pig (kg/day)			2.32
18.	Time birth->weaning			28.82
19.	weaners (days)			30.35
20.	feeders (days)			116.09
21.	Weight Birth (kg)			1.37
22.	Weaning (kg)			7.35
23.	Feeder (kg)			22.30
24.	Market (kg)			108.09
25.	Cull boars (kg)			258.33
26.	Cull sows (kg)			196.67
27.	Market index			100.00

B: OPERATING COSTS
Feed Costs

1.	Dry stock	18.19 cents/kg
2.	Nursing sows	18.84 cents/kg
3.	Creep feed	59.80 cents/kg
4.	Starter feed	32.62 cents/kg
5.	Feeder feed	18.03 cents/kg
6.	Service costs	17149.18 $/year
7.	Labour costs	32245.20 $/year
8.	Operating interest (%)	12.00%
9.	Marketing cost (%)	4.39%

D: RETURNS

	$/kg	Dressing %
1. Price of market pigs	$0.950	78.000%
2. Price of cull sows *	75.000%	75.000%
3. Price of cull boars *	50.000%	

* Expressed as a percent of the market pig price

ANALYSIS DISPLAY

1. **NET RETURNS = -$33399.31**
2. **BREAKEVEN PRICE = $1.089**

-$164.53 / FEMALE MAINTAINED

AVG FARM (100 HD FEMALES) = -$173.79 / FEMALE

Net Returns = Income after all operating costs have been met, all debts serviced, and labour income has been provided for family living.
= Return to management, equity, capital, and depreciation.
= Money available for asset replacement, growth, investment and increased living standards.

Breakeven Price = Price to ensure that all costs are met.

Figure 8
BUDGET #1

AVERAGE (reasonable values) FARM

100 HD (89.6 SOWS &10.4 GILTS)
(values are averages from 300 hd 1988 ISU summary, NAHMS surveys, or this budget program's reasonable values)

A: HERD PARAMETERS
(Physical inputs)

1.	Sows	89.60		Feed	
2.	Gilts	10.40	12.	Feed boar (kg/yr)	996.45
3.	Boars	4.94	13.	dry sow (kg/yr)	785.10
4.	Replacement % sows	38.33	14.	nursing sow (kg/yr)	243.08
5.	Replacement % boars	43.33	15.	Creep/litter(kg/day)	0.68
6.	Litters/sow/year	1.82	16.	Starter/pig (kg/day)	6.68
7.	Pigs born alive/litter	10.00	17.	Feeder/pig (kg/day)	2.40
8.	% death birth->weaning	14.99%	18.	Time birth->weaning	28.00
9.	weaners	3.33%	19.	weaners (days)	43.00
10.	feeders	1.00%	20.	feeders (days)	111.00
11.	breeding stock	1.67%	21.	Weight Birth (kg)	1.37
			22.	Weaning (kg)	7.00
			23.	Feeder (kg)	22.27
			24.	Market (kg)	108.63
			25.	Cull boars (kg)	258.33
			26.	Cull sows (kg)	196.67
			27.	Market index	100.00

B: OPERATING COSTS
Feed Costs

1.	Dry stock	18.47 cents/kg
2.	Nursing sows	18.88 cents/kg
3.	Creep feed	56.23 cents/kg
4.	Starter feed	31.88 cents/kg
5.	Feeder feed	17.92 cents/kg
6.	Service costs	8697.17 $/year
7.	Labour costs	13800.00 $/year
8.	Operating interest (%)	12.00%
9.	Marketing cost (%)	4.25%

D: RETURNS

	$/kg	Dressing %
1. Price of market pigs	$0.950	78.000%
2. Price of cull sows *	75.000%	75.000%
3. Price of cull boars *	50.000%	

* Expressed as a percent of the market pig price

ANALYSIS DISPLAY

1. NET RETURNS = -$17378.87
2. BREAKEVEN PRICE = $1.099
-$173.79 / FEMALE MAINTAINED

Net Returns = Income after all operating costs have been met, all debts serviced, and labour income has been provided for family living.
= Return to management, equity, capital, and depreciation.
= Money available for asset replacement, growth, investment and increased living standards.
Breakeven Price = Price to ensure that all costs are met.

BUDGET #3

MEDIUM FARM

(36 TO 84 HD)

AVG = 57 FEMALES (51 SOWS & 6 GILTS) FOR 18 FARMS

A: HERD PARAMETERS
(Physical inputs)

1.	Sows	51.00	12.	Feed boar (kg/yr) 888.89
2.	Gilts	6.00	13.	dry sow (kg/yr) 901.03
3.	Boars	3.00	14.	nursing sow (kg/yr) 293.91
4.	Replacement % sows	38.33	15.	Creep/litter(kg/day) 0.21
5.	Replacement % boars	43.33	16.	Starter/pig (kg/day) 0.85
6.	Litters/sow/year	1.82	17.	Feeder/pig (kg/day) 2.06
7.	Pigs born alive/litter	9.32	18.	Time birth->weaning 32.37
8.	% death birth->weaning	14.59%	19.	weaners (days) 27.98
9.	weaners	3.33%	20.	feeders (days) 108.36
10.	feeders	1.00%	21.	Weight Birth (kg) 1.37
11.	breeding stock	1.67%	22.	Weaning (kg) 8.59
			23.	Feeder (kg) 20.88
			24.	Market (kg) 100.75
			25.	Cull boars (kg) 258.33
			26.	Cull sows (kg) 196.67
			27.	Market index 100.00

B: OPERATING COSTS
Feed Costs

1.	Dry stock	16.29 cents/kg
2.	Nursing sows	17.27 cents/kg
3.	Creep feed	50.72 cents/kg
4.	Starter feed	30.72 cents/kg
5.	Feeder feed	17.21 cents/kg
6.	Service costs	4660.75 $/year
7.	Labour costs	17272.68 $/year
8.	Operating interest (%)	12.00%
9.	Marketing cost (%)	3.73%

D: RETURNS

	$/kg	Dressing %
1. Price of market pigs	$0.950	78.000%
2. Price of cull sows *	75.000%	75.000%
3. Price of cull boars *	50.000%	

* Expressed as a percent of the market pig price

ANALYSIS DISPLAY

1. NET RETURNS = -$15146.41
2. BREAKEVEN PRICE = $1.212

-$265.73 / FEMALE MAINTAINED

AVG FARM (100 HD FEMALES) = -$173.79 / FEMALE

Net Returns = Income after all operating costs have been met, all debts serviced, and labour income has been provided for family living.
= Return to management, equity, capital, and depreciation.
= Money available for asset replacement, growth, investment and increased living standards.

Breakeven Price = Price to ensure that all costs are met.

Figure 10
BUDGET #4

SMALL FARM

(LESS THAN OR = TO 35 HD)

AVG = 23 FEMALES (21 SOWS & 2 GILTS) FOR 18 FARMS

A: HERD PARAMETERS
(Physical inputs)

1.	Sows	21.00	12.	Feed boar (kg/yr)	685.38
2.	Gilts	2.00	13.	dry sow (kg/yr)	771.73
3.	Boars	1.00	14.	nursing sow (kg/yr)	204.23
4.	Replacement % sows	38.33	15.	Creep/litter(kg/day)	0.28
5.	Replacement % boars	43.33	16.	Starter/pig (kg/day)	0.84
6.	Litters/sow/year	1.82	17.	Feeder/pig (kg/day)	2.66
7.	Pigs born alive/litter	9.16	18.	Time birth->weaning	44.00
8.	% death birth->weaning	16.59%	19.	weaners (days)	20.53
9.	weaners	3.33%	20.	feeders (days)	112.90
10.	feeders	1.00%	21.	Weight Birth (kg)	1.37
11.	breeding stock	1.67%	22.	Weaning (kg)	11.67
			23.	Feeder (kg)	23.79
			24.	Market (kg)	107.33
			25.	Cull boars (kg)	258.33
			26.	Cull sows (kg)	196.67
			27.	Market index	100.00

B: OPERATING COSTS
Feed Costs

1.	Dry stock	26.38 cents/kg
2.	Nursing sows	23.28 cents/kg
3.	Creep feed	38.35 cents/kg
4.	Starter feed	28.19 cents/kg
5.	Feeder feed	18.76 cents/kg
6.	Service costs	2803.34 $/year
7.	Labour costs	6340.50 $/year
8.	Operating interest (%)	12.00%
9.	Marketing cost (%)	4.31%

D: RETURNS

	$/kg	Dressing %
1. Price of market pigs	$0.950	78.000%
2. Price of cull sows *	75.000%	75.000%
3. Price of cull boars *	50.000%	

* Expressed as a percent of the market pig price

ANALYSIS DISPLAY

1. NET RETURNS = -$11180.21
2. BREAKEVEN PRICE = $1.410

-$486.10 / FEMALE MAINTAINED

AVG FARM (100 HD FEMALES) = -$173.79 / FEMALE

Net Returns = Income after all operating costs have been met, all debts serviced, and labour income has been provided for family living.
= Return to management, equity, capital, and depreciation.
= Money available for asset replacement, growth, investment and increased living standards.

Breakeven Price = Price to ensure that all costs are met.

Figure 11

BUDGET #5

AVERAGE (reasonable values) FARM

100 HD (89.6 SOWS &10.4 GILTS)
(values are averages from 300 hd 1988 ISU summary, NAHMS surveys, or this budget program's reasonable values)

B: OPERATING COSTS
Feed Costs

1. Dry stock	15.11	cents/kg
2. Nursing sows	15.11	cents/kg
3. Creep feed	15.11	cents/kg
4. Starter feed	15.11	cents/kg
5. Feeder feed	15.11	cents/kg
6. Service costs	8697.17	$/year
7. Labour costs	13800.00	$/year
8. Operating interest (%)	12.00%	
9. Marketing cost (%)	4.25%	

1988 ISU DATA
Avg cost of all diets

ANALYSIS DISPLAY

1. NET RETURNS = $4667.27
2. BREAKEVEN PRICE = $0.910

+$46.67 / FEMALE MAINTAINED

LARGE FARM

(GREATER THAN OR = TO 85 HD)
AVG = 203 FEMALES (182 SOWS & 21 GILTS) FOR 18 FARMS

B: OPERATING COSTS
Feed Costs

1. Dry stock	15.11	cents/kg
2. Nursing sows	15.11	cents/kg
3. Creep feed	15.11	cents/kg
4. Starter feed	15.11	cents/kg
5. Feeder feed	15.11	cents/kg
6. Service costs	17149.18	$/year
7. Labour costs	32245.20	$/year
8. Operating interest (%)	12.00%	
9. Marketing cost (%)	4.39%	

1988 ISU DATA
Avg cost of all diets

ANALYSIS DISPLAY

1. NET RETURNS = $8562.78
2. BREAKEVEN PRICE = $0.914

+$42.18 / FEMALE MAINTAINED

Average Estimated Increase to Returns Over Operating Expenses on a Sow per Year Basis

Potential Change	Estimated Increase
Increase pigs born alive per litter by 5 percent	$41.00
Decrease purchased feed prices by 5 percent	$49.00
Decrease baby pig mortality in farrowing phase by 1 percentage point	$10.00
Decrease mortality by 1 percentage point in each phase	$28.00
Increase litters per sow per year by 5 percent	$38.00
Decrease days in finish phase by 5 percent	$51.00

Source: National Animal Health Monitoring System (NAHMS) Wisconsin Field Study. Reprinted from the Animal Health Insight, Spring 1990.

Table 4

Use of Epidemiologic Principles for Training Needs Assessment

by

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Abstract.--The National Animal Health Monitoring System (NAHMS) is a relatively new program for Veterinary Services within the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture. This program reflects a changing direction for the agency--for example, a shift from a focus on the individual animal to profitability and efficiency of the livestock industry as a whole. Any major change such as this new program usually mandates a shift in job descriptions, and NAHMS is no exception. With changing expectations of personnel involved with NAHMS, training becomes a critical component of program implementation. The program is at a point where a thorough training needs assessment is necessary.

This paper will describe the survey design, sample selection, data collection, and analysis used for the needs assessment. The data was analyzed using Epi Info.

Fumonisins: Newly Identified Mycotoxins

by

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Fumonisins B^1, B^2, and B^3 are newly characterized mycotoxins that are produced by *Fusarium moniliforme* and *Fusarium proliferatum*. Under both experimental and natural conditions, fumonisins have been linked to equine leukoencephalomalacia (ELEM), equine liver disease, and porcine pulmonary edema (PPE). Porcine liver disease and rat hepatic cancer have been linked with fumonisins experimentally.

Corn and corn screenings are a significant source of fumonisins, and a wide range of levels have been found in naturally contaminated feed. To determine what levels of fumonisin B^1 (FB^1) in feeds are associated with equine leukoencephalomalacia, 45 selected cases were studied. The FB^1 concentrations ranged from less than 1 ppm to 126 ppm with the majority of the samples above 10 ppm. All types of feeds were included: corn, screenings, sweet feeds, and commercially pelleted rations. The length of exposure varied from seven to more than 35 days. Equine feed samples not associated with ELEM were also collected and analyzed, and none of the nonproblem feed samples contained FB^1 levels above 8 ppm.

Thin-layer chromatography, high-performance liquid chromatography, and gas chromatography/mass spectroscopy were utilized to identify and quantitate FB^1.

Feed samples associated with cases of porcine pulmonary edema contained 20-360 ppm FB^1.

Further work is being done at the National Veterinary Services Laboratories to fully characterize the toxicity of fumonisins.

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Table 1. *FB_1 concentrations in feeds associated with PPE.*

Identification	Type of Sample[a]	FB_1 ug/g
Samples from Iowa		
018	Screenings	16
099	" (2)	56, 113
100	"	120
102	"	20
128	"	209
140	"	20
189	"	73
224	"	153
101	Corn (4)	3, 6, 50, 39
112	"	2
239	"	less than 5
393	" (2)	13, 26
394	"	14
395	"	27
097	Complete ration (4)	83, 23, 20, 22
236	"	less than 5
380	"	4
384	" (3)	24, 12, 13
023	Corn	3[c]
	Screenings	ND[b,c]
075	Corn	4
	Screenings	178
096	Corn (2)	195, 189
	Screenings (2)	330, 252
098	Corn	67
	Screenings	44
392	Screenings	36
	Corn	44
	Complete ration	29

(Table 1 continued)

Samples from Illinois

024	Screenings	58[c]
025	"	16[c]
037	"	99
062	"	92[c]
064	" (2)	330[c], 136[c]
381	"	121
914	Complete ration (3)	16, 3, ND
114	" (3)	4, 4, 1
127	" (5)	23, 25, 7, 17, 5
091	Corn	4
	Screenings	119
185	Complete ration (2)	9, 5
	Screenings (2)	134, 176
324	Complete ration (2)	95, 121
	Screenings	131
347	Complete ration	ND
	Corn	less than 5

Samples from other states

126	Georgia	Corn	ND
012	Georgia	Corn Screenings (2)	105[c], 155[c]
142	North Carolina	Complete ration	3
148	Indiana	Complete ration (2)	4, 3
183	New York	Complete ration (5)	all ND
253	Louisiana	Complete ration (2)	ND, 6

[a]Number of samples indicated in parenthesis if more than 1.
[b]ND indicates none detected, below 1 ug/g.
[c]Confirmed by GC/MS.

Table 2. *FB_1 levels in feeds associated with ELEM.*

Identification	Type of Sample[a]	FB_1 ug/g
Samples from Iowa		
137	Corn	27
138	Corn (2)	2, 16
139	Oats	ND[b]
095	Corn	12
	Screenings	2
256	Corn	20
	Sweet feed	8

(Table 2 continued)

Samples from Illinois

131	Screenings	36
320	"	72
321	"	14
322	"	76
129	Corn	3
130	Sweet feed	16
985	Complete ration (6)	17, 8, 10, 3, 55, 89
185	" (5)	12, 26, 2, 8, 91

Samples from Texas

082	Screenings	ND
122	" (3)	9, 14, 61
063	Corn/oats mix	24[c]
963	Sweet feed	20[c]
348	Corn	4
	Screenings	125
863	Corn	33[c]
	Sweet feed	94[c]
078	Corn	29
	Sweet feed	27

Samples from Louisiana

331	Screenings	42
332	" (5)	54, 71, 69, 55, 40
350	"	56
364	" (7)	24, 14, 30, 21, 40
		95, 40
371	" (2)	31, 50
251	Complete ration (3)	5, 7, ND
278	" (2)	4, 5
288	" (3)	12, 7, 19
264	Pelleted ration (4)	22, 16, 5, 5
330	Sweet feed	4
363	Silage	13
211	Pelleted ration (2)	14, 5
	Sweet feed	ND

Samples from other states

065	Arizona	Screenings	122[c]
143	Arizona	Screenings (3)	58[c], 37[c], 126[c]
		Pelleted ration (2)	both ND
		Sweet feed	ND
		Alfalfa pellets	less than 5
		Bran	ND
123	Virginia	Pelleted ration	ND
173	Virginia	Sweet feed	ND
384	Virginia	Sweet feed (4)	all less than 5[c]
		Pelleted ration	less than 5[c]

(Table 2 continued)

132	North Carolina	Corn	4
		Feed	4
342	Georgia	Complete ration	12
421	Georgia	Sweet feed (2)	13, ND
252	Mississippi	Sweet feed	29
420	Mississippi	Ear Corn	ND
		Sweet feed	18
004	Maryland	Corn (2)	both less than 10[c]
		Sweet feed	ND
188	Delaware	Corn	19

[a]Number of samples indicated in parenthesis if more than 1.
[b]ND indicates none detected, below 1 ug/g.
[c]Confirmed by GC/MS.

Assessment of Certain Problems Associated with the Use of Vaccine in a Pseudorabies Virus Eradication Program

by

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A survey of private veterinarians was conducted to investigate potential problems involved in the use of pseudorabies vaccine in an eradication program. Forty-five out of 70 veterinarians responded identifying these program problems: 37 serological herd tests they felt were inconclusive, 15 herds they felt were unnecessarily quarantined due to inconclusive test results, and 18 herds experiencing a delay of quarantine release due to inconclusive test results. In addition, 11 deaths in other species including dogs, sheep, and cattle were reported due to the administration of MLV pseudorabies vaccine[1]. In general, however, the problems were found to be small compared with the total picture and isolated to a small number of practices. The theoretical program costs these problems would generate were calculated.

The use of vaccine as a tool in the control of pseudorabies has been well established over a period of many years.[2,3,4,5] In Illinois, the vaccine has provided a means by which producers, who would otherwise be devastated by disease, were enabled to continue to raise swine.[6,7] In 1989, we witnessed the advent of vaccines with companion tests which could differentiate serum antibodies produced as a result of exposure to field virus from those produced by the vaccine. This innovation produced hope that vaccine would now be a useful tool in eradicating as well as controlling pseudorabies.

The new vaccines, despite their advantages, did not come without drawbacks. First of all, since each new vaccine was created with a different pattern of gene deletion, each test could only be used to differentiate a specific vaccine. If more than one brand of vaccine is administered to an otherwise pseudorabies-negative animal, antibodies to each vaccine is likely to be produced. The antibodies produced by one vaccine will be interpreted as field virus by a test which is not specific to that vaccine.[8] The results of such a test, in this case, would be inconclusive or possibly misleading.

When the Illinois State Animal Disease Laboratory-Galesburg began reporting ambiguous test results from herds vaccinated with more than one vaccine, concern was raised regarding the program costs in dealing with the associated problems. How many fee basis payments would be made for tests which yielded little if any useful information? How many herds would be unnecessarily quarantined on the basis of inconclusive test results? How many herds scheduled for quarantine release would be delayed until animals vaccinated with more than one vaccine were removed from the herd? In addition to program costs, there was extra burden placed upon producers required to assemble and restrain the animals and upon the veterinarians required to collect samples and submit them for testing.

The second problem was first noticed as a result of discussions with private veterinarians and producers. It was felt by some that because the new vaccines were genetically altered by deleting genes, they were "safer" and could be used in other species. Previous reports have documented the lethal effect of earlier modified-live pseudorabies

vaccines on other species,[9,10] but these individuals felt it was somehow different now. Again, when the Illinois State Animal Disease Laboratory-Galesburg reported virus isolation of pseudorabies virus in specimens of species other than swine, we investigated the possibility of vaccine exposure. In the case of at least one canine and one bovine specimen, pure cultures of vaccine virus were detected.

A total of 70 questionnaires were sent to all Illinois veterinarians having performed fee-basis testing for the Illinois pseudorabies eradication program during the period from 1 January 1990 to 1 July 1990. Due to the delicate nature of some of the questions, confidentiality was guaranteed by not asking for information which would identify the practice such as name, location, and number of quarantined herds in the practice.

The first three questions established a practice profile of swine herds served during the first six months of 1990 according to number of herds served, the type of vaccine used in the herd, and the number of serological tests conducted by vaccine type. The practices were grouped according to size in intervals of 1-24 herds, 25-49 herds, 50-99 herds, and 100-250 herds. The vaccine categories were: (1) herds vaccinated with Norden (Pr-Vac, SmithKline-Beechum) only, (2) herds vaccinated with Syntrovet (PRV/Marker, Syntrovet) only, (3) herds vaccinated with Upjohn (Tolvid, Upjohn) only, (4) herds vaccinated with another vaccine brand only, (5) herds vaccinated with two or more brands, and (6) herds not vaccinated for PrV. A summary of these results can be found in Table 1.

The next three questions were intended to collect information on: the number of inconclusive test results, the number of unnecessary quarantines issued, and the number of delayed quarantine releases, all according to vaccine type used. The vaccine categories were the same as in questions one and two. These results are summarized in Table 2.

Question seven was intended to determine whether or not the herds were intentionally vaccinated with more than one brand of vaccine and the reasons. Questions eight and nine were intended to collect information regarding deaths in other species. The data is found in Tables 3 and 4. Question 10 was for written comments.

The author realizes the responses are subjective in the majority of cases. That is due to the busy nature of most veterinary practices, the tendency to give estimates rather than exact figures, and the fact that the questionnaire was done by mail rather than administered in person. For this reason, care was taken to not overgeneralize or to assign risk factors based on finely defined statistical associations. Rather, the most obvious trends are pointed out from which logical conclusions can be drawn and decisions made.

The first area of concern was the magnitude of the problem with inconclusive test results. It is this problem upon which the other problems of unnecessary quarantines and quarantine release delays hinge. The observation is that the magnitude of the problem is small overall. The study included 2,873 herd; 1,181 of these herds were tested in the first six months of 1990, of which 37 (3%) experienced inconclusive test results. What, then, were the factors associated with this problem? At first glance at Fig. 1, it would seem that as the practice size increases, the percent of inconclusive tests experienced by the practice decreases. This, however, is misleading due to the small numbers of inconclusive tests within each practice size interval. Other confounding factors are probably involved. Are the smaller practices less involved in pseudorabies testing, less experienced in interpreting test charts, less confident in the results, and consequently more apt to report positive results as inconclusive? On the other hand, are the larger practices so accustomed to reading many positive charts that they fail to question the results?

Fig. 2 and Fig. 3 summarize the role of vaccine type in the occurrence of inconclusive tests. Inconclusive tests were reported in all categories with the exception of "Upjohn" and

"Other Vacc" where there were very few herds tested compared with the other categories. By far the greatest percentage of inconclusive tests within a category was found in the category of "Multi Vacc" which refers to those herds vaccinated with two or more brands of pseudorabies vaccine. Approximately 26% of "Multi Vacc" herds tested experienced inconclusive results. This compares with 14% "Norden," 5% "Syntrovet," and 1% "Non Vacc."

Table 3 shows that of all the "Multi Vacc" herds, only four were unintentionally vaccinated through contaminated syringes, the purchase of the "wrong" vaccine at another location, or reliance on inaccurate records. These four herds were all located in the same practice. All other multiple vaccination was intentional, i.e., a change of vaccine was planned by the producer and the veterinarian because of cost, efficacy, or other reasons.

Deaths in other species (Table 4) were low in number (11), limited to a small number of practices (5), and not limited to a particular vaccine. Also, four canine deaths were reported to have been due to intentional vaccination. All other deaths (7) were due to accidental vaccine exposure.

When the number of problems per practice (the number of inconclusive tests + the number of unnecessary quarantines + the number of quarantine release delays + the number of deaths in other species / the total number of practices) is examined, two observations are made. Fig. 4 indicates that as the number of vaccines used within a practice increases, the number of problems within a practice also increases. The problems in categories "No Vacc" and "4 Vacc" are due to the effects of the problems in only one practice for each category. The other categories contain larger numbers and depict a nearly straight line. From Fig. 5 we also see that 78% of the problems were reported by 10 practices and that the top five practices accounted for 48%.

A cost estimate was calculated using the following rationale. An inconclusive test necessitates a visit by a regulatory veterinarian to discuss the test result and arrange a retest plus payment to the fee-basis veterinarian for conducting the retest. An unnecessary quarantine necessitates an initial visit by a regulatory veterinarian to conduct an epidemiological investigation and develop a herd plan, fee-basis payment for a test of the finishing herd to confirm that no virus is spreading, at least two follow-up visits to monitor herd status and arrange testing, and at least two herd tests for quarantine release. A quarantine release delay necessitates fee-basis payment for a test of the finishing herd, fee basis payment for an extra herd test, and at least two extra visits. Table 5 lists the cost figures for each problem and gives a key to the variables used. No attempt was made to calculate the cost of the deaths in other species.

In conclusion, the problems were small in number, were mostly limited to a few practices, increased as the number of vaccines used within the practice increased, and not limited to a particular vaccine but associated with the use of more than one vaccine within a herd. Whether the cost figures are alarming depends on the perspective of the observer, but to this author, $13,950 sounds like money worth saving.

Some discussion of possible confounding factors is probably in order. Location of the practice, i.e., whether or not it was in a pseudorabies endemic area, may have some effect. The fact that this period of time came shortly after the advent the differential tests could indicate a transition period in which practices would be switching brands of vaccine until they found one with which they were comfortable. Whatever the case, some obvious recommendations can be made to veterinarians regarding the use of pseudorabies vaccines--the same recommendations that have been made before: (1) limit the use of vaccine to one brand per herd, (2) try to limit the use of vaccine to one brand per practice, (3) keep accurate records on vaccine purchased and dispensed, (4) avoid testing

swine vaccinated with more than one brand of MLV pseudorabies vaccine, (5) administer MLV pseudorabies vaccine to swine only, and (6) exercise caution when handling the vaccine and cleaning syringes.

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Table 1.

PRACTICE SIZE

	ALL PRACTICES			1 TO 24 HERDS			25 TO 49 HERDS			50 TO 99 HERDS			100 TO 250 HERDS		
	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%
VACCINE USED															
TOTAL	45	2873		13	154		7	245		13	865		12	1609	
NORDEN	14	167	6%	2	3	2%	1	12	5%	6	86	10%	5	65	4%
SYNTROVET	34	527	18%	8	17	11%	5	14	6%	12	157	18%	9	338	21%
UPJOHN	2	6	0%	0	0	0%	0	0	0%	2	6	1%	0	0	0%
OTHER VACC	3	6	0%	1	2	1%	1	1	0%	0	0	0%	1	3	0%
MULTI VACC	12	45	2%	2	5	3%	2	9	4%	3	20	2%	5	11	1%
NO VACC	40	2123	74%	11	127	83%	7	209	85%	13	596	69%	9	1191	74%
HERDS TESTED/VACCINE TYPE															
TOTAL	45	1181		13	96		7	95		13	452		12	538	
NORDEN	10	64	5%	1	2	2%	1	9	9%	6	45	10%	2	8	1%
SYNTROVET	33	189	16%	8	16	17%	4	18	19%	12	114	25%	9	41	8%
UPJOHN	2	6	1%	0	0	0%	0	0	0%	2	6	1%	0	0	0%
OTHER VACC	1	3	0%	0	0	0%	0	0	0%	0	0	0%	1	3	1%
MULTI VACC	7	23	2%	2	5	5%	1	7	7%	3	10	2%	1	1	0%
NO VACC	38	896	76%	9	73	76%	6	61	64%	13	277	61%	10	485	90%

Tables Key:

Pr = Number of veterinary practices
Herds = Number of swine herds
% = Percent of total herds in the interval

Table 2.

PRACTICE SIZE

	ALL PRACTICES			1 TO 24 HERDS			25 TO 49 HERDS			50 TO 99 HERDS			100 TO 250 HERDS		
	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%
INCONCLUSIVE TESTS															
TOTAL	45	37		3	11		2	5		9	18		2	3	
NORDEN	6	9	24%	0	0	0%	1	3	60%	5	6	33%	0	0	0%
SYNTROVET	8	11	30%	2	2	18%	1	2	40%	4	6	33%	1	1	33%
UPJOHN	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
OTHER VACC	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
MULTI VACC	3	6	16%	1	2	18%	0	0	0%	2	4	22%	0	0	0%
NO VACC	3	11	30%	1	7	64%	0	0	0%	1	2	11%	1	2	67%
UNNECESSARY QUARANTINES															
TOTAL	11	15		3	3		1	2		5	7		2	3	
NORDEN	1	1	7%	0	0	0%	0	0	0%	1	1	14%	0	0	0%
SYNTROVET	6	7	47%	1	1	33%	1	1	50%	3	4	57%	1	1	33%
UPJOHN	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
OTHER VACC	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
MULTI VACC	2	2	13%	1	1	33%	1	1	50%	0	0	0%	0	0	0%
NO VACC	4	5	33%	1	1	33%	0	0	0%	2	2	29%	1	2	67%
QUARANTINE RELEASE DELAYS															
TOTAL	12	18		3	4		1	2		7	11		1	1	
NORDEN	3	3	17%	0	0	0%	0	0	0%	3	3	27%	0	0	0%
SYNTROVET	6	6	33%	1	1	25%	1	1	50%	3	3	27%	1	1	100%
UPJOHN	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
OTHER VACC	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
MULTI VACC	4	7	39%	1	2	50%	1	1	50%	2	4	36%	0	0	0%
NO VACC	2	2	11%	1	1	25%	0	0	0%	1	1	9%	0	0	0%

Table 3.

	PRACTICE SIZE														
	ALL PRACTICES			1 TO 24 HERDS			25 TO 49 HERDS			50 TO 99 HERDS			100 TO 250 HERDS		
	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%	# PR	# HERDS	%
MULTIPLE VACCINATION INTENTIONAL?															
YES	11	42	91%	2	5	100%	2	9	100%	2	16	80%	5	12	100%
NO	1	4	9%	0	0	0%	0	0	0%	1	4	20%	0	0	0%
REASON FOR UNINTENTIONAL MULTITIPLE VACCINATION															
CONTAMINATED SYRINGE	1	1.0	25%	0	0		0	0	0%	1	1	25%	0	0	0%
WRONG VACCINE DISPENSED	0	0.0	0%	0	0		0	0	0%	0	0	0%	0	0	0%
WRONG VACCINE PURCHASED	1	1.0	25%	0	0		0	0	0%	1	1	25%	0	0	0%
INCOMPLETE RECORDS	1	2.0	50%	0	0		0	0	0%	1	2	50%	0	0	0%

Table 4.

DEATHS IN OTHER SPECIES DUE TO PRV VACCINE

	# PRACTICES	# DEATHS	VACCINATION INTENTIONAL?		VACCINE USED			
			YES	NO	NORDEN	SYNTROVET	UPJOHN	OTHER
BOVINE	1	2		2	0	0	2	0
OVINE	1	1		1	1	0	0	0
CANINE	3	8	4	4	2	6	0	0
OTHER	0	0		0	0	0	0	0
TOTAL	5	11	4	7	3	6	2	0

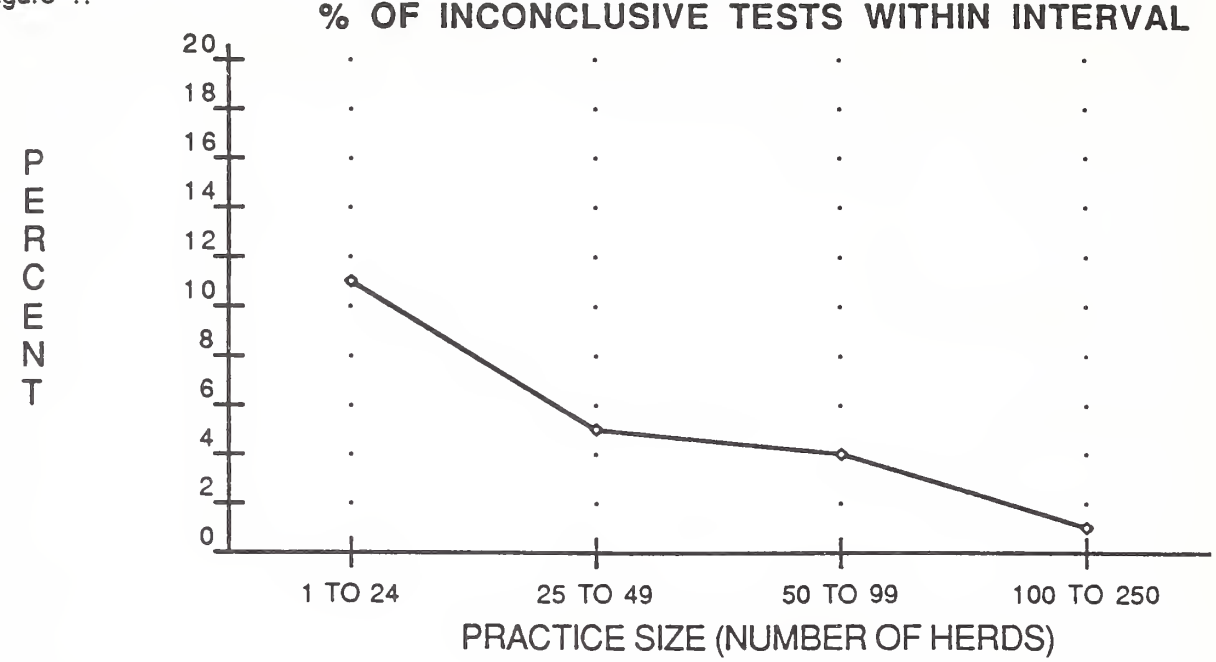
% OF INCONCLUSIVE TESTS WITHIN INTERVAL
PERCENT
20
18
16
14
12
10
8
6
4
2
0
1 TO 24
25 TO 49
50 TO 99
100 TO 250
PRACTICE SIZE (NUMBER OF HERDS)

Figure 2

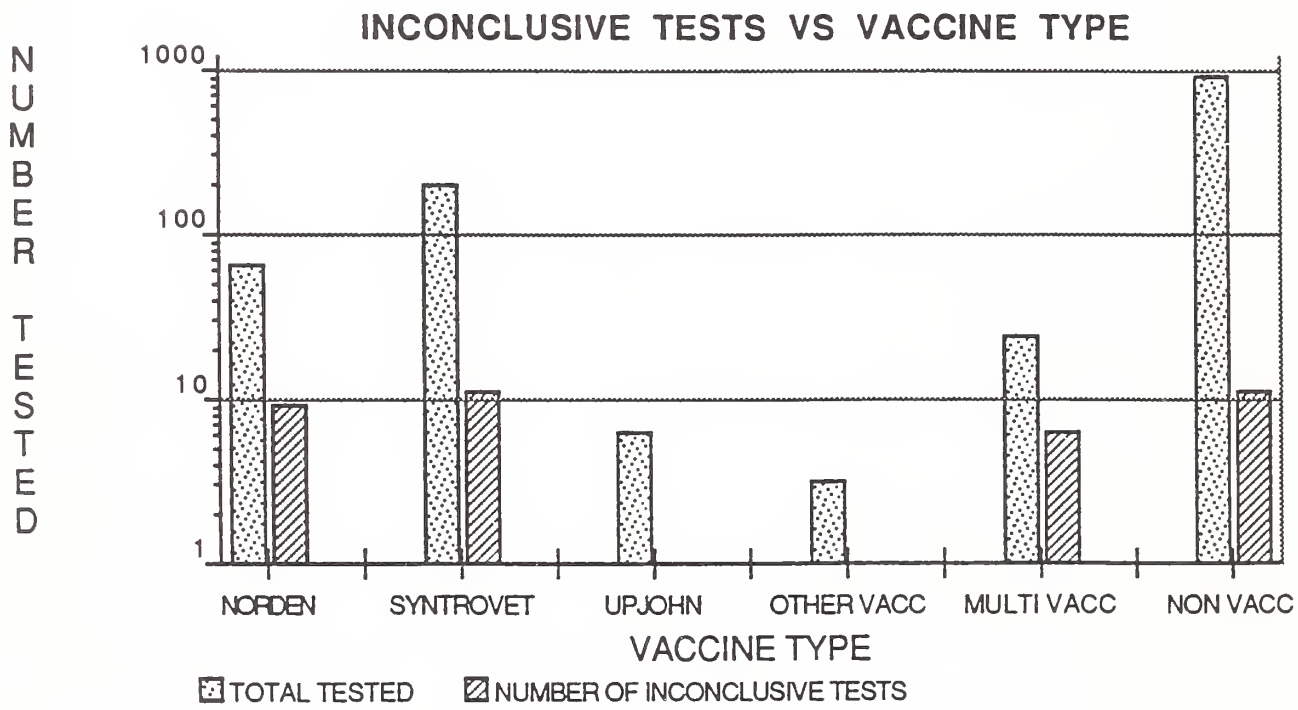
INCONCLUSIVE TESTS VS VACCINE TYPE
NUMBER TESTED
1000
100
10
1
NORDEN
SYNTROVET
UPJOHN
OTHER VACC
MULTI VACC
NON VACC
VACCINE TYPE
TOTAL TESTED
NUMBER OF INCONCLUSIVE TESTS

Figure 3.

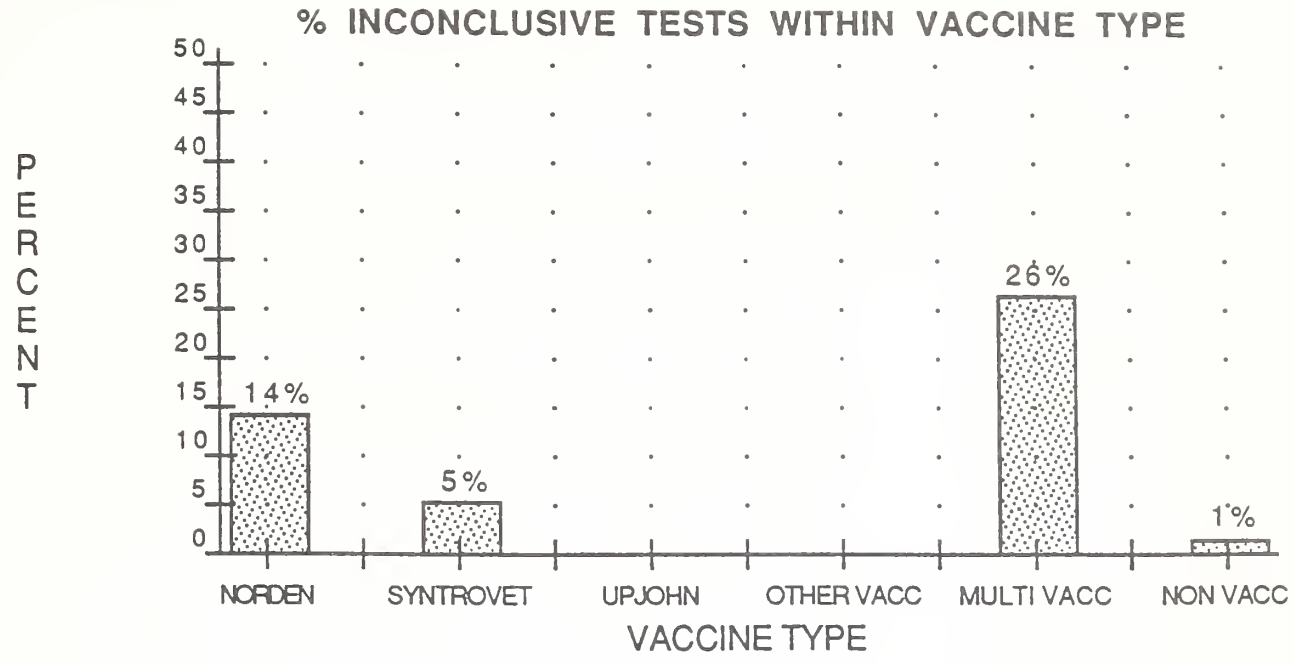

Figure 4.

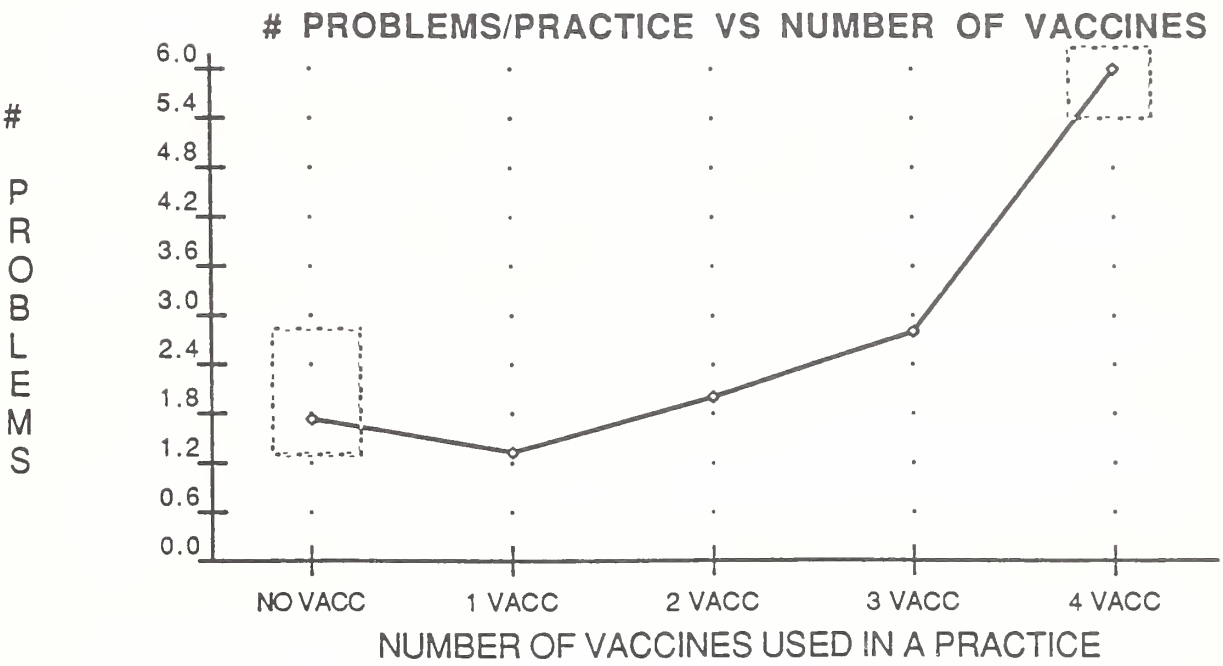

Figure 5.

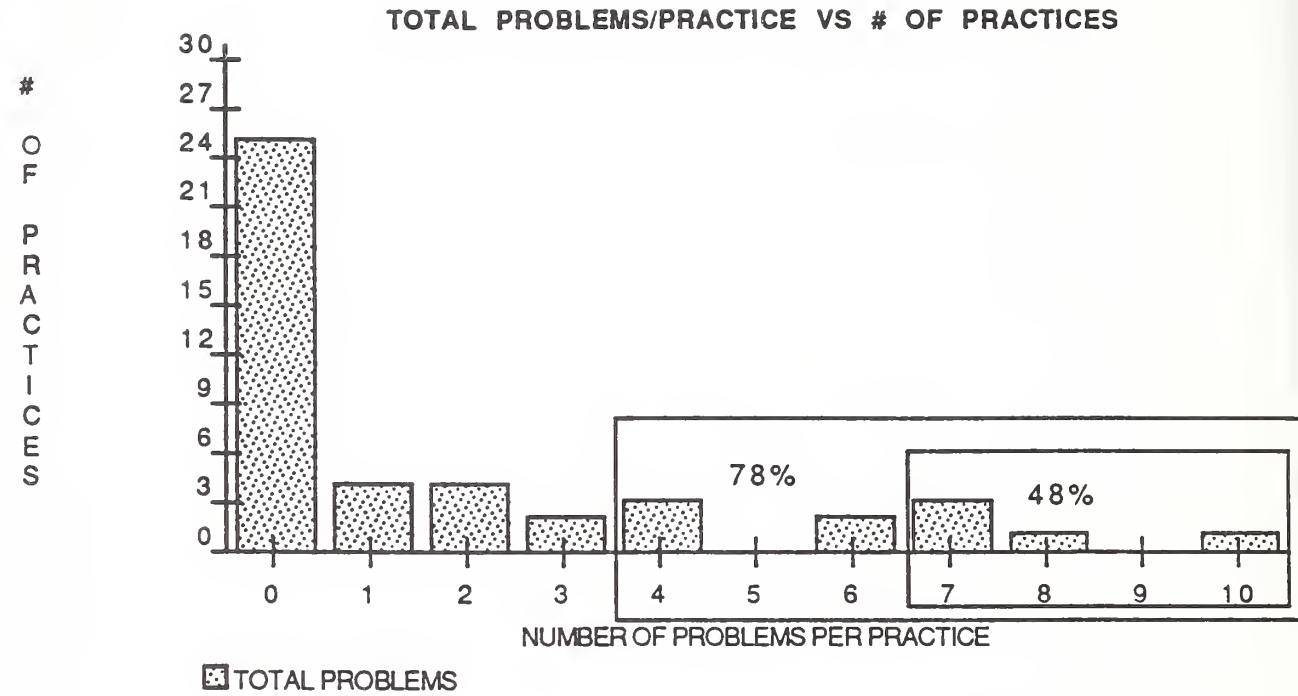

Table 5.

TOTAL COST	
INCONCLUSIVE TESTS	
1 VISIT+1 HERD TEST	$4440.00
UNNECSSARY QUARANTINE	
1 INITIAL VISIT+2 FOLLOW UP VISITS+1 TEST OF FINISHERS+2 HERD TESTS	$5550.00
QUARANTINE RELEASE DELAY	
1 TEST OF FINISHERS+1 EXTRA HERD TEST+2 EXTRA VISITS	$3960.00
TOTAL	$13950.00

KEY:

VISIT	REGULATORY VET'S TIME @ $30/HR * 1 HOUR
INITIAL VISIT	REGULATORY VET'S TIME @ $30/HR * 2 HOURS
FINISHER TEST	$70 FEE BASIS PAYMENT ON TEST OF 20 FINISHERS
HERD TEST	$90 FEE BASIS PAMENT ON TEST OF 30 ADULT BREEDING STOCK

Comparison of Brucellosis-Infected Adult-Vaccinated Herds and Nonadult-Vaccinated Herds in Mississippi

by

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Abstract.--Forty-three adult vaccinated herds and 53 nonadult vaccinated herds were compared according to the length of quarantine, total number of reactors removed, and total number of tests required to qualify the herd to be released from quarantine. The data were obtained from Mississippi program records from 1977 to 1990. Selection of the herds in the study was based on: (1) initial infection ["high infection rate" is defined as greater than or equal to 10% reactors on the initial test(s)] and (2) herd size ("small" is defined as less than or equal to 36 head. Differences noted included: (1) length of time under quarantine, (2) number of reactors removed during quarantine, and (3) number of total herd tests during quarantine. Economic concerns regarding adult vaccination will be addressed.

Mississippi is currently in a countdown phase in the brucellosis program along with the other Class B states. We have steadily been dropping in our accumulated infected herd numbers (Table 1).

Table 1. *Accumulated infected herds in Mississippi.*

FY 1987	FY 1988	FY 1989	FY 1990
304	140	144	118

The newly infected herd numbers have dropped since June and remain at a low level although we are still seeing large runs through the Mississippi markets (first point testing). The drop in newly infected herds is not unusual this time of year. We will be awaiting the new year to confirm our improving status (Graph 1).

The number of identified infected herds has dramatically fallen since FY 1987, during which time several area tests were in progress. Mississippi had another smaller scale (two counties) area test early FY 1989 (Graph 2).

There have been several positive activities that have contributed to the decrease in numbers of infected herds and newly infected herds in Mississippi. These activities include depopulation, adult vaccination, restriction of heifers born into an infected herd until tested negative following calving, S-branding restricted heifers or fee-basis spaying

of the restricted heifers (offering the producer alternatives in commerce), and one-mile radius testing around the infected premises.

Depopulation has been utilized along with active epidemiological tracing and testing. In FY 1990, the state of Mississippi added $100 on top of the federal $50 indemnity for a period of three months (May, June, and July). That incentive contributed to the dramatic drop in the numbers of infected herds in our state.

Adult vaccination in Mississippi is the tool of choice if depopulation is not a viable option for the producer. Adult vaccination has been utilized to improve the immunity of the adult cattle in infected herds. It was utilized widely in the late 1970's and early 1980's in Mississippi when we were not yet using the currently available liquid adult vaccine. There were many high titered animals removed from these herds for as many as six months after initial adult vaccination. Although the majority of the reactors removed were field strain brucellosis reactors, a few of these were strain 19 titered animals, as culture results have shown. The use of even this difficult to deliver adult vaccine had assisted in controlling and eliminating infection in infected herds in Mississippi. The current liquid adult vaccine used delivers a more accurate dose with fewer animals retaining vaccine titers following vaccination.

In April 1988, Dr. Doug Tanner, the area veterinarian in charge, and the Mississippi state veterinarian, with the backing of the Mississippi Board of Animal Health, passed a regulation stating that all infected herds must either depopulate, adult vaccinate, or test at 30-45 day intervals. This regulation was enhanced in 1989, by requiring identified infected herds to only have the option to depopulate or adult vaccinate.

Case Definition

A herd will be defined as an infected brucellosis herd if there has been tissue or milk cultured positive for Brucella abortus or if more than one reactor has been identified as an on-the-farm reactor in the herd in question. All cases had to have been tested to be released according to the UM&R for Brucellosis Eradication (1986, updated 1988).

Methods

This study was retrospective, utilizing data collected from the Mississippi program records section. The herd history information spanned the years 1977 to 1990. Infected herd status was assigned to all herds studied that fulfilled the "case definition" as stated previously. I will present my preliminary results on 96 brucellosis infected herds in Mississippi.

Epi Info Version 5 was used to handle the research data in this study. The majority of the data, because of the desired sample size and time frame of study, was not available from the Mississippi computerized records. The majority of the data was obtained through manual file searches. The data are now in Epi Info 5 and will be available for further study.

The data obtained from the adult-vaccinated herds were analyzed using Epi Info. Phone conversations with Dr. Jim Alexander (NAHMS in Fort Collins, Colorado), and a review of his study of adult-vaccinated and nonadult-vaccinated brucellosis-infected cattle herds in Texas gave me added information to assist in my study.

Results

There are 96 herds comprising this study. Forty-five percent of the herds in the study were adult vaccinated. The Mississippi brucellosis-infected adult vaccinated herds were

divided artificially into large and small herds (small herds </= 36 head). Analysis of the data revealed that 50% of the small herds were adult vaccinated and 50% were nonadult vaccinated. The larger herds, on the other hand, had 40% in the adult vaccinated group (Table 2).

Table 2. *Mississippi brucellosis-infected herds--adult-vaccinated herds.*

Herd Size	AV	Non-AV	Totals
Small (</= 36 head)	24	24	48
Large	19	29	48

The frequency of adult vaccinated herds with high initial infection (>/= 10% reactors removed on initial test) was calculated to add to the validity of the case definition. Sixty-seven percent of the adult vaccinated herds had an initial high infection rate in the herd.

The final results indicate that adult vaccination does in fact improve the outcome, regarding brucellosis as well as the economic concerns of the farmer/rancher. As is noted in Table 3, the adult vaccinated herds had consistently fewer days under quarantine, fewer reactors removed, and fewer whole-herd tests through the quarantine period to release.

Table 3. *Mississippi brucellosis-infected herds--comparison of adult-vaccinated versus nonadult-vaccinated herds.*

Adult vaccinated	Days quarantined	Number reactors	Number test	Number herds
Yes	519+/-227	10.2	6.6	43
No	550+/-330	16.5	9.3	53

This is only a preliminary study. I plan to continue compiling data to create a larger more representative population sample.

Graph 3 represents all herds in this study. This graph demonstrates in a pie chart the number of tests, percentage-wise, required to satisfy a quarantine release. Thirty-three percent of the herds required nine to 17 tests. Graph 4, which focuses on the adult vaccinated herds, shows only 12 of the herds required nine to a maximum of 14 tests to satisfy a quarantine release. These two graphs demonstrate one of the primary economic benefits of adult vaccination.

Economic Concerns

Direct costs of brucellosis must be taken into consideration when addressing a disease prevention program. These costs include: loss of facilities due to quarantine for disease eradication and disease control activities, owners kept from normal money-making jobs due to requirements for testing, increased labor costs and transportation costs, costs of

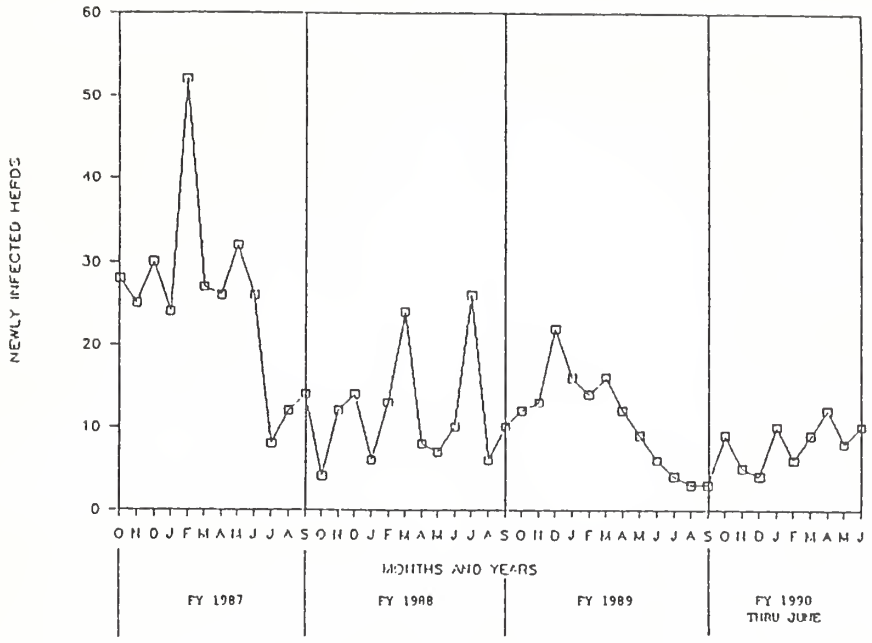
isolation and disinfection due to abortions, loss of potential calf crop (through abortions and weak calves), loss of productive value (including loss of fertility in bulls), loss of markets, increased risk of other cattle pastured near the infected herd, loss of export markets, and losses due to forced sale of reactor animals.

The costs of prevention include: labor to carry out prevention program, cost of vaccination, fencing (to isolate import animals, to separate preparturition animals from the herd, and to separate pastures), and increased cost in purchasing replacement stock. The cost of the disease is far greater than the cost of prevention.

Conclusion

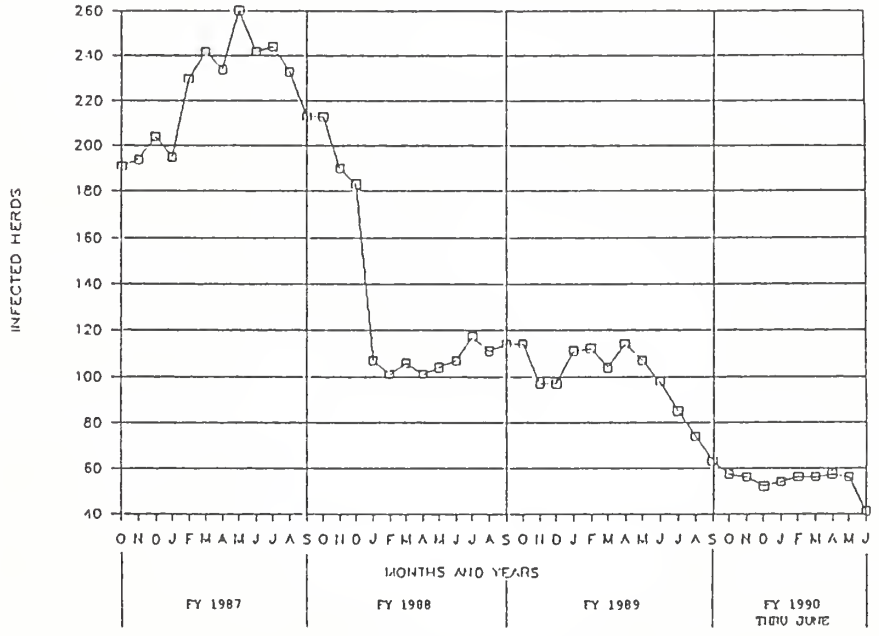
As noted throughout this presentation, adult vaccination is utilized successfully in Mississippi. This tool is used in herds identified as brucellosis infected and will decrease the total number of reactors removed from an infected herd, suggesting increased herd immunity; it will decrease the total number of herd tests required for release; and it will decrease the quarantine period that is economically restrictive to the herd owner. These economic gains will aid the farmer/rancher who must deal with a brucellosis-infected herd. It is a useful tool to be used along with our other tools to eradicate this disease. Soon, we will all be heading towards "free" status!

MISSISSIPPI
NEWLY INFECTED HERDS STATUS



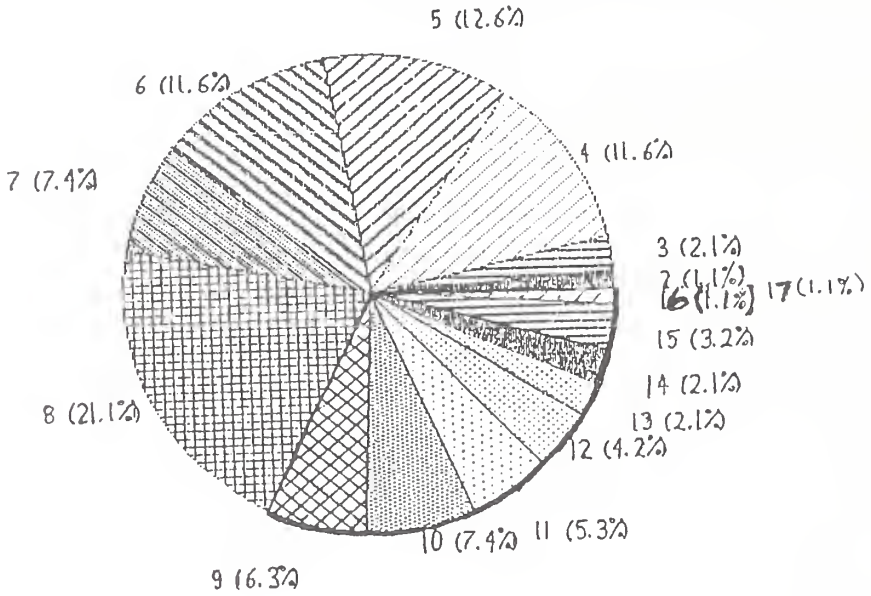
GRAPH 1

MISSISSIPPI
INFECTED HERDS STATUS



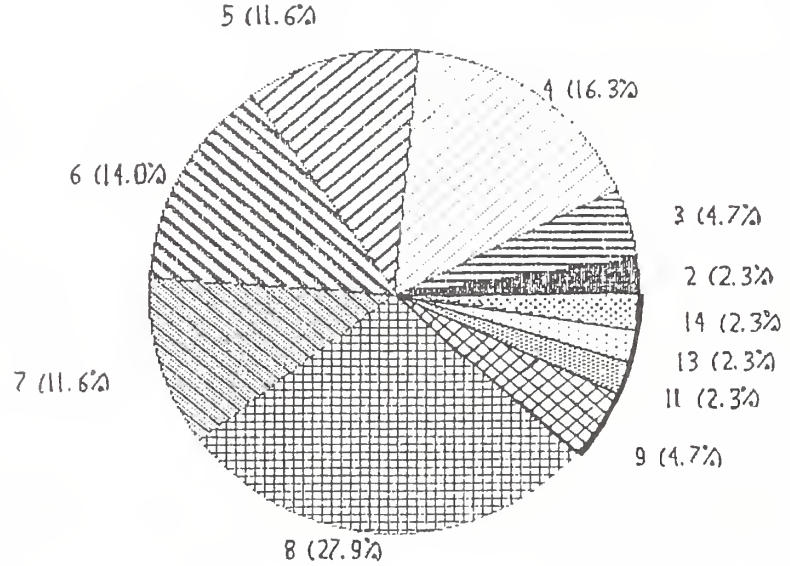
GRAPH 2

MISSISSIPPI BRUCELLOSIS INFECTED HERDS
All Herds
Number of Tests Required to Satisfy a Quarantine Release



GRAPH 3

MISSISSIPPI BRUCELLOSIS INFECTED HERDS
Adult Vaccinated Herds
Number of Tests Required to Satisfy a Quarantine Release



GRAPH 4

Effective Communication of Scientific Information

by

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Abstract.--One of the greatest challenges the National Animal Health Monitoring System (NAHMS) faces is effective communication of scientific information. This dilemma is in part due to the variety of audiences the program addresses and the scope of the project itself. The audience and scope are reflected in the NAHMS mission statement: "To protect and improve animal and human health, assure quality and abundance of food and fiber, and keep United States' agriculture competitive by collecting, analyzing, and providing users with information on the epidemiology and economics of animal health and productivity." This presentation focuses on how NAHMS addresses the enigma of effective communication of scientific information; the challenges of dealing with a wide variety of audiences; and the application of principles for collecting, analyzing, and disseminating information.

Introduction

Communication is a "hot topic" these days. Is it because this area is not adequately covered in the curriculum of academia? Or is it because we work in such a highly competitive marketplace that this skill has become essential to the success of each and every one of us?

Communication, in general, is a chain of events in which the significant link is a message. Effective communication is a necessary part of policy making in business, education, industry, and government. The nature, process, and effects of social communication are the subject of endless theorizing and a vast amount of research.

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), and Veterinary Services (VS) recognizes the importance of developing new methods of securing information on animals. The NAHMS program, sponsored by USDA/APHIS/VS uses epidemiology and economic data to provide information on animal health.

NAHMS' mission statement clearly identifies three very important communication issues: collect, analyze, and provide users with information.

Collection Process

The process NAHMS uses to design a national survey is based on six key questions: Who? What? Where? When? Why? and How?

Who? NAHMS utilizes the APHIS/VS infrastructure of more than 400 veterinary medical officers (VMO's) to complete the monitoring and surveys of the selected herds. What? The National Swine Survey collects information on sows and their piglets during

the farrowing period (birth to weaning). Where? Information is collected in 18 states from approximately 1,400 participating swine operations. When? The time frame for the National Swine Survey is December 1989 through December 1990. Why? The purpose of collecting this information is to describe death and illnesses of animals during this period and evaluate management, environment, and economic interactions with health, productivity, and profitability. How? Each producer keeps prospective daily records (diary cards) on farrowing sows and their litters for a three-month period. Three questionnaires are also administered to each participating producer by the VMO's during the monitoring phase.

Analysis Process

The process for analyzing data involves three steps: enter, store, and retrieve. Information is entered into a personal computer at the state level, transmitted on a quarterly basis via modem, and stored on a national NAHMS database. Information is retrieved in various formats including: individual producer reports, state summary reports, and national summary reports.

Dissemination Process

Perhaps the most crucial aspect of any project is that of disseminating the information! It doesn't matter how much effort is put into a program, if the results are not distributed, then all the effort is lost.

Dissemination of information can be done by: verbal (one-on-one conversation), written (i.e., letters, reports, brochures), and public presentations (combination of verbal and written). However, to effectively communicate, you must collect and analyze before you can disseminate!

Effective Communication Tips

- Identify your audience
- Determine your presentation method (i.e., verbal, written, or public presentation)
- Deliver the results

Verbal Communication Tips

It is not always what you say, but how you say it. In the NAHMS program, verbal conversation is sometimes the best method for getting the results out or for immediate answers to difficult problems.

- State your objective
- Avoid technical jargon
- Do not use excessive or stilted wordiness
- Choose the proper level of language

Written Communication Tips

Materials to help reach identified audiences include letters, brochures, fact sheets, state summary reports, producer reports, and technical reports. This documentation not only informs the public but also persuades and influences participants in the NAHMS program.

- Identify the audience (technical vs. non-technical)
- Determine the format (i.e., letter, report, brochure)
- Write an outline (list major topics)

- Develop the text (to support the results)
- Prepare graphics (visual presentation of materials)
- Review and edit (have someone else help with this)
- Produce and distribute (disseminate the information)

Public Presentation Tips

This method of disseminating information combines both verbal and written communication skills. In order to distribute results on the NAHMS program, many public presentations are necessary to capture targeted audiences. These include presentations to large audiences at symposiums, universities, workshops, and seminars.

- Identify your audience (technical vs. non-technical)
- Determine the content of your topic (results)
- Prepare a script (list major topics)
- Choose the delivery (flip chart, overheads, slides)
- Present the material (give the speech)

Visual Aids

Graphics are used as a pictorial way or visual method for presenting information. In general, an audience is more likely to remember a message if seen (visual presentation) rather than heard. However, the importance of using the right type of graphics for the data is important. Examples include:

- Bar chart--compares two or more different items
- Flow chart--- shows a sequence or process
- Organization chart--shows the chain of command
- Pie chart--shows parts or percentages

Synopsis

There are many tools, tips, and techniques available to help in effective communication. This skill is not something we are born with or inherit; it is something each of us must continually strive to improve.

One more tip: The shortest distance between two points is a straight line. The more words you use to express a thought, the longer it takes your audience to grasp the idea. The best way to communicate effectively is: let thy words be few!

Conveyances with small, circular frames
turning on their axes should never
precede members of the Equidae family.

* * * * * * * *

Never put the cart before the horse!

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Summarizing and Reporting Veterinary Diagnostic Laboratory Results on a National Basis: the DxMONITOR

by

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Abstract.--Veterinary diagnostic laboratories provide a service to the food animal industry by diagnosing diseases. During this process a huge amount of disease information is created in each laboratory. In order to effectively understand, predict and control animal disease across the United States, it is vital that this data be collected and reported on a national basis. The DxMONITOR is an effort by the American Association of Veterinary Laboratory Diagnosticians (AAVLD) and the United States Animal Health Association (USAHA) to accomplish this goal of national disease reporting. Diagnostic laboratories are sending data to the National Center for Animal Health Information Systems in Fort Collins, Colorado, where it is collated, statistically analyzed and reported in the DxMONITOR.

Introduction

The purpose of this presentation is to summarize ongoing efforts to collect diagnostic laboratory information for reporting of animal diseases. I will cover the following topics: the need for this reporting, the background leading up to the first issue, the format of the DxMONITOR, and the future of the DxMONITOR.

I would like to recall the incoming message last year of Dr. Gavin Meerdink, President of AAVLD. He compared the enormous information reserve of veterinary diagnostic laboratories to a large pile of wood to be split. His grandfather warned him to "...concentrate on where to swing the axe. If you measure the pile you have to split, you will become complacent." The DxMONITOR is another important log that has been split so that the information can be utilized. The potential of the split wood is not evident in the trees in the forest, but as we keep splitting each log, we are closer to releasing the energy.

Need for Nationwide Reporting

The need for reporting has been discussed at length, and there are many examples where accurate data collection and reporting has proved or disproved a hypothesis. The nuclear reactor accident at Chernobyl in 1986 is an excellent example. Monitoring and mapping the spread of contamination provided information in the form of maps to demonstrate where food animals and crops should be avoided for consumption. These maps also demonstrated the areas needing evacuation and decontamination.

The need for nationwide disease surveillance has been documented many times. At a recent World Association of Veterinary Laboratory Diagnosticians conference in Guelph,

Dr. John. A. Kellar plotted the number of animals seen on the x-axis and the detail seen per animal on the y-axis. As you can see, diagnostic laboratories are at the pinnacle of this curve with a greater depth of intimacy and detail than any other group. The practitioner gets less detail about the individual animal, but may not be aware of state or national trends. The state herd health officials have a more composite view from the herd health approach but less information about each animal. At the bottom of the curve is the federal program with massive numbers of animals but little detail about each animal. All four groups perform monitoring according to their responsibilities and methods.

In order to capitalize on the ultimate strengths of diagnostic lab data, a nationwide collection analysis and reporting system is needed. When the nationwide information is assembled, facts and trends can be derived so that diagnostic labs can be informed, practitioners can better understand what to expect on the farm, and state and federal governments can make program decisions to maximize cost-benefit in this day of shrinking budgets.

Background

In 1987, a joint AAVLD/USAHA committee assessed the feasibility of a centralized location to collect, analyze and report animal disease data. In 1988, the NAHMS staff conducted a survey in two parts: first, to assess support for the effort and second, to collect data about specific tests and classes of animals. In the first survey, 66 percent (21/32) of the labs responded and more than 90 percent (19/21) of the labs stated a willingness to supply data for the report. All indicated they would be interested in the report, and more than 75 percent (16/21) are presently storing data on a computer.

The diagnostic test questionnaire collected information on the most common diseases tested for and which tests were being used in the case of specific diseases. The most common disease for cattle was brucellosis, for swine was pseudorabies, for equine was EIA, and for poultry was mycoplasma. The table summarizes the most common test used and frequency for anaplasmosis in cattle, *Salmonella cholerasuis* in swine, EIA in horses, and *S. typhimurium* in poultry.

Table. *Survey Results: Most Common Test Used and Frequency of Selected Diseases.*

	Bovine	Swine	Equine	Poultry
Specific disease for survey	Anaplasmosis	*Salmonella cholerasuis var. kuzendorf*	EIA	*Salmonella typhimurium*
Most common test used	CF	API-0E	AGID	Group B Salmonella
Frequency	69%	42%	67.3%	47%

The recommendations of these surveys are:

- USAHA/AAVLD joint committee should review the findings of the survey and recommend further development of a reporting system.

- AAVLD should consider recommendations for minimum standards for positive tests.
- In recommending further development, specific directives and guidance (outcomes) are needed.

A planning committee was formed with personnel from six labs serving as members. It met on 15 June 1990 to develop a prototype information collection and reporting mechanism beginning with California, Nebraska, South Dakota, Minnesota, and New York state diagnostic laboratories, and the National Veterinary Services Laboratory in Ames, Iowa. The committee established guidelines for the format for a quarterly summary report to be distributed to each lab.

The result of all this effort is the Fall 1990 premier issue of the DxMONITOR dedicated to the late Dr. Richard F. (Buzz) Hall of Tifton, Georgia, who actively promoted the idea of a reporting system to serve both the AAVLD and USAHA.

Premier Issue of DxMONITOR, Fall 1990

The purpose of the Fall issue of the DxMONITOR is to be a prototype information collection and reporting mechanism beginning with a few laboratories. It is to be distributed to the committee and other interested parties for comments and suggestions for improvements.

It consists of three parts as suggested by the committee. Section I is Coast-to-Coast Patterns of Selected Disease, Section II is Specific Etiologic Agents Associated with Calf Diarrhea, and Section III is Lab Notes.

Section I: Coast-to-Coast Patterns of Selected Diseases contains information about a variety of diseases of current interest from the Organization Internationale Epizootic (OIE) list. The purpose of this section is to report and monitor patterns of confirmed cases of specific diseases on a state by state basis so that national distributions can be mapped. Sources of the data will be the state diagnostic laboratories as well as APHIS and other nationwide studies. The diseases to be dealt with initially are tuberculosis in cattle, equine arboviral encephalitis, equine infectious anemia, and brucellosis, as well as data from diagnostic labs on bluetongue, leptospirosis, and bovine leucosis.

Section II: Specific Etiologic Agents Associated with Calf Diarrhea characterizes agents most commonly associated with accessions in veterinary diagnostic laboratories with clinical signs or history of the calf diarrhea. This information is important in applying the diagnostic laboratory data with the epidemiology of dairy diseases. This will also tie in with the dairy survey to be conducted by the National Animal Health Management System. Agents included are BVD, coccidia, coronavirus, cryptosporidia, *E. coli*, rotavirus and *Salmonella sp.*

Section III: Lab Notes will present short descriptions of current investigations, outbreaks or items of potential interest to diagnostic laboratories. The purpose is to provide a forum for timely exchanges of information within the diagnostic laboratory community.

In Sections I and II, the committee established the criteria for a positive test to be counted for the DxMONITOR. This is an attempt to standardize the information in the DxMONITOR between the different labs, each with its own policies.

DxMONITOR Plans

The Fall issue of the DxMONITOR will be widely disseminated to users and potential users through the mail and at this meeting. It is hoped that readers will give us feedback as to what is right and what is wrong with this initial effort. Suggestions and changes will be collected for the next three issues--Fall 90, Winter 90, and Spring 91. Representatives of the diagnostic laboratories are scheduled to meet again in June 1991 to incorporate improvements and changes into a revised format. These changes will be reported to the 1991 USAHA meeting for approval.

Another goal for the DxMONITOR is to recruit at least 10 more labs in the near future to widen the scope of the reporting and to get more support for nationwide reporting. Controlled growth will allow the staff of the DxMONITOR to learn how to handle the potentially large mass of lab data in the future.

Factors Affecting the Sensitivity of the Erythrocyte Protoporphyrin Screening Test for Elevated Blood Lead Levels, Chicago, Illinois, 1988-1989

by

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The sensitivity of the erythrocyte protoporphyrin (EP) screening test for elevated blood lead (BPb) levels in children was found to be low (23% and 46%) in two recent population-based studies. We examined the sensitivity of the EP test in a screening clinic population to determine factors that cause higher sensitivity estimates for this high-risk group than for the population-based studies.

The Centers for Disease Control (CDC) recommends measurement of erythrocyte protoporphyrin as a screening test for elevated blood lead levels in children. It defines an elevated BPb level as >25 ug/dL and a positive EP screening test as >35 ug/dL. In 1984, an estimated 250,000 children in the United States had elevated BPb levels. We studied childhood lead data from the city of Chicago program, one of the few programs to test for BPb and EP levels in every sample. In September 1989, we selected a systematic sample of 1,176 (2% of the total) records of tests conducted from July 1988 to September 1989. Of these, 630 (53.6%) were for children tested in city screening clinics. BPb levels were elevated in 50 (7.9%) of the screening clinic tests; EP levels were elevated in 143 (22.7%). The sensitivity of EP as a screening test was 70% and the specificity was 81%.

We concluded that two related factors account for much of the difference between the sensitivity estimates from the Chicago screening-clinic population and those from the population-based studies. First, because EP levels increase logarithmically as BPb levels increase, the EP sensitivity was higher for subgroups with BPb levels >35 ug/dL than for subgroups with BPb levels of 25-34 ug/dL. Second, the screening-clinic population has a higher percentage of children with a BPb level >35 ug/dL than does the general population. Iron deficiency among the screening-clinic population is another factor likely to increase the apparent sensitivity of the EP test. The available data did not allow us to directly study this factor.

Epidemiology Tools: Using Chaos Mathematics to Predict Pseudorabies Outbreaks in High Incidence States

by

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Abstract.--As Animal and Plant Health Inspection Service/Veterinary Services begins to collect large amounts of data on the pseudorabies virus (PRV), it may become possible to predict the spread of this disease based on "Chaotic Outbreaks" among large herd populations. Outbreaks of PRV can be compared to epidemiological models that are expressed as a set of four mathematical nonlinear equations, the result of which is a single positive exponent value. This positive exponent can be estimated with current Veterinary Services data and used in "Chaotic Mandelbrot fractal" equations to determine seemingly random (non-periodic) outbreaks of PRV.

Using data collected on negative (N) animals, exposed (E) animals, positive (P), those animals testing positive, and vaccinated (V) animals that are no longer a threat to the population, we can trace outbreaks over time and fit the data into the mathematical nonlinear differential NEPV equations. Using our current computer technology to perform Chaotic functions could offer Veterinary Services a tool to assist in the eradication and control of Pseudorabies virus. NEPV equations may be used to understand the total disease population of high incidence states and reveal how outbreaks of PRV occur in chaotic nonperiodic patterns. Then perhaps by using these tools disease outbreaks can be better understood and possibly predicted.

Through the use of Chaos mathematics, medicine has been able to model outbreaks of measles and chicken pox in human populations and reproduce cyclic and chaotic patterns that compare favorably with historical data sets for these diseases[1]. Outbreaks of human disease can be represented as either periodic behavior in the presence of random variation, or as chaotic patterns of infection corresponding to alternating patterns of high and low incident years. Some of the modeling procedures used with human disease might be applicable to diseases affecting both individual and herds of domestic animals.

Comparison of real world data and data produced from these epidemiological models suggests that measles epidemics are inherently chaotic. Conversely, chicken pox outbreaks approximate a yearly cycle inversely related to the size of the exposed population. Pseudorabies is caused by a herpes virus like chicken pox[2,3]. Like the *herpes zoster* infections in man, pseudorabies virus (PRV) can manifest as a latent or subclinical infection in swine. Latency is defined as a long-term persistent infection in the host from which the infectious virus cannot be recovered. As a family, herpes viruses may remain latent for years, then for some reason it reactivates, whereupon the virus may be shed to infect a new host. If clinical signs are apparent due to the reactivated virus, the process is referred to as recrudescence. Herpes viruses, because of their ability to remain in a latent

state, have an ability to persist in the host population. This presents a problem for eradication procedures.

Epidemiological models used in the human studies to look at chicken pox and measles are identified as nonlinear "SEIR" equations, an acronym for Susceptible-Exposed-Infectious-Recovered. For the pseudorabies virus the population is broken down into the following groups: N = negative, P = positive, E = exposed, V = vaccinated. The NEPV categories compose the total tested swine population in any defined geographic area. Animals testing negative are classified as negative. Infected animals are those in the area of interest identified as infected by an accepted positive pseudorabies test result. Vaccinated animals are those with an active vaccination status. Exposed animals are negative animals having had exposure to an infected animal in a herd under investigation. The number exposed is an adjusted number of negative animals, not the reported total number of negative animals. The total population (T) is the total number of pigs residing in the geographic area of interest.

The following nonlinear equations are used to describe the status for swine with regard to pseudorabies in a specific geographic area in question:

the number of negatives,	$dN/dt = m(T - N) - bNP$
the number of exposed,	$dE/dt = bNP - (m + a)E$
the number of positives,	$dP/dt = aE - (m + g)P$
and the number of vaccinated animals,	$dV/dt = gP - mV$

for the total population (T). T is generally assumed to be constant; for convenience it is normalized to 1 permitting the stated variables to be expressed as a proportion of the total, where $N + E + P + V = 1$. Average life expectancy is represented by $1/m$. Respectively, $1/a$ and $1/g$ are mean latency and mean infectious periods for the virus in host animals. In the model, "b" represents the effective contact rate, or the average fraction of negatives contacted by a single infected animal.

The effective contact rate, "b," is a critical value that must be estimated from a sample population. It is not available from any specific report for a specific geographic area. The contact rate is estimated from known outbreaks affecting an individual herd or herds. That rate is then applied to a larger geographic area. This estimated value is subject to sampling and selection bias that will have a tendency to underestimate the prevalence of PRV infections; this tends to bias the results toward the null, but is considered acceptable because of its conservative nature.

The average age of the infected animals is determined to be the average age of the infected animal as a weaner, feeder, or breeder. Values of "m," "a," and "g" are appropriate for various locales and diseases and can be obtained directly from census data (Agriculture Statistics), the Pseudorabies Monitoring System, or the Quarterly National Report. The value of "m" usually comes from the Quarterly National Report, and "a" and "g" from current medical literature.

Disease prevalence ratios can be estimated from current data in Veterinary Services National Programs collection software (PRMS). These equations represent the total population of swine in a specific geographic area and their status in relation to pseudorabies. As the contact rate between animals increases either on a seasonal basis or as a result of movement, stress, and/or management practices, there will be a tendency to cause the NEPV equations to behave more chaotically. In pseudorabies, as with other herpes infections, the population size and isolation rates are important factors that shape the pattern of infection. To accurately model the disease using the NEPV equations, a correction must be made for an interaction occurring between population size and transmission efficiency; this correction factor is the contact rate "b."

When parameters, including the contact rate, average life expectancy, and mean latent and infectious periods, are held constant, the resulting data display a damped oscillation that is not consistent with patterns of data from observed real world outbreaks. This can occur with NEPV models for pseudorabies. To make the NEPV model look more like a real epidemic, additional variables affecting the contact rate must be introduced. These include the level and type of confinement, seasonal variations in the weather, virulence of the strain of PRV, and other management practices such as farrowing and weaning times. When one adjusts for the effect of seasonal variation with regard to the contact rate the resulting adjustment factor becomes b(t) = b(o)(1 + cos*2pi*t) where "t" is a predetermined unit of time. With seasonal time adjustment added to the dependent NEPV equations, the eventual high and low patterns of chaos begin to mirror true data obtained from observation of real world epidemics and/or outbreaks of PRV. The nonperiodic pattern associated with CHAOS is often hard to identify because of divergence from an orderly cyclic pattern usually occurring on an exponential scale rather than on an additive scale[5].

Correction factors, such as the contact rate for seasonal variation, are important sources of noise that adjust the epidemiological model to correct for biases that distort epidemiological records. There are reporting errors occurring when a veterinarian fails or neglects to report the presence of pseudorabies in a herd or reports a misdiagnosis of pseudorabies. This may result in a month-to-month fluctuation of the percent of PRV infections reported. Secondly, there are random fluctuations associated with the dynamics of the disease and the system. These can result from changes in the population size associated with fluctuating birth and death rates, chance variations in weather, and random movement of infectives into and out of the overall population. Finally, there is an intrinsic probability element which results from dealing with a finite population size. One problem is that transmission of infectious diseases follows the probability rules and thus there is the possibility of chance extinction occurring in a small population[6,7].

In human disease and perhaps in pseudorabies there is a "critical community size," defined as a minimum population density for which a disease such as PRV will not die out as a result of chance extinction. As noted by Bartlett and others, recurrent measles epidemics in small isolated populations are controlled by chance extinction and chance introduction. These factors are independent of the infective contact rate adjusted for the seasonal factors and long term deterministic variables affecting the dynamics of the disease process. Larger populations that experience the introduction of new animals into the population and/or herd are less likely to experience chance extinctions of the PRV infection because the disease patterns are more likely to depend on the contact rate. Also, there are other dynamic factors tending to influence disease patterns. A population of 300,000 appears to be necessary to ensure continued survival of measles in the human population. In contrast, the minimum host population for pseudorabies to ensure the continuation of the disease without chance extinction appears to be a 1,000 pigs[8]. The seasonality issue as well as the other dynamic issues are necessary to explain the dynamics of the disease when looking at a large population of swine. In small populations of pigs, the dynamics of the disease appear to be controlled more by chance extinction and immigration factors than by chaos.

Important components in determining population density for positive to negative ratios are the ability to select a specific geographic area, find the numbers of negative animals (N) and the number of positive animals (P), and estimate the exposure (E) rate of the disease for this geographic area. For each geographic area, we can determine the contact rate "b" for a given population. Once "b" has been determined, it is possible to predict whether an area will move toward a crisis situation, resulting in a chaotic outbreak of the disease[9]. Once determination has been made that the geographic area in question is a candidate for a chaotic outbreak, a concentrated effort could be made to vaccinate or

depopulate the local herd. The one assumption that needs to be verified is that PRV outbreaks are population dependent, and that for large populations within a given geographic area the probability that pseudorabies makes the transition towards a Chaos is high. To adequately determine population densities within a geographic area, software and hardware exist to create digitized maps that show herd populations with the numbers of negatives and positives. Digitized maps yield themselves to Boolean set manipulation where it becomes a simple task to graphically display information from the existing pseudorabies databases for numbers of positive, negative, and vaccinated animals.

Some assumptions are made about the relationship between pseudorabies disease vectors and the chaotic outbreaks occurring over time. Underlying all these assumptions is population density--the higher the population, the more "regular" the chaotic patterns over a long period of time. For smaller populations, there is a higher probability of the disease not being transmitted to negatives at the time of an outbreak. This makes it difficult to determine the "predictable" chaotic patterns.

The NEPV equations, for which one can compute as many points as needed, represent a chaotic map which is a chaos pattern because successive magnifications of small pieces reveal a fine structure similar to the original map[10,11]. If the points are labeled in temporal sequence, for Xi then Xi + 1 = F(xi, Xi - 1), with a singular dependence on Xi-1. If the population density is great enough to sustain a chaotic pattern, then is there sufficient noise from other data elements (especially PRV contact rate) to show that chaos is an integral part of the equation?

It is hoped that through the application of this type of epidemiological modeling it will become possible to accurately predict the geographic direction of spread of this disease in addition to the magnitude of its effect on the pork industry. It is hoped that such modeling procedures will help to identify as yet undocumented risk factors related to specific environmental factors and management practices utilized in areas having large sustained swine populations.

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Geographical Information System Pilot Study for the Brucellosis Eradication Program in Florida

by

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Significant strides have been made in eradicating brucellosis in Florida over the last few years. However, we have always had difficulty in determining the impact of terrain, land use, hydrology, and other man-made barriers in our eradication effort.

Florida is unique in that much of the land that cattle are raised on is in the south central part of the state where the land is not well suited for urban development. There are numerous lakes, rivers, and swamps, and depending on rainfall, it frequently becomes difficult, if not impossible, to effect a complete gathering of the herd for testing.

Further, large tracts of land are owned by mining companies and, because of the tax structure, they lease out the land for cattle production. Thus, ownership and location of many cattle herds are highly volatile, and movement of animals is frequently a short-notice situation. Another major complicating factor is the large turnover of field Veterinary Medical Officers (VMO's) during the past several years. The intimate knowledge and understanding of the various herds and husbandry practices are lost when a VMO transfers.

We have a large amount of herd summary and individual animal testing results, as well as herd owner, bacteriologic culture, and epidemiology information, in a Brucellosis Recording and Reporting System (BRRS) Oracle Relational Data Base Management System on a Digital Equipment Corporation's VAX 6310 computer.

What we do not have, is the capability to map the physical boundaries of the affected herds, or graphically relate the locations and distances between the various affected and nonaffected herds. This is the kind of information that the Section VMO builds up over the years while working with the affected herds. This information is lost when the VMO transfers to another assignment. Another shortcoming is that we cannot directly utilize any of the BRRS Oracle database information in any graphical form.

Therefore, we have volunteered to conduct a pilot study to evaluate the feasibility, efficiency, and effectiveness that a Geographical Information System (GIS) can provide as a management and epidemiological tool in the brucellosis eradication effort. GIS technology uses computer generated digital maps to pinpoint the location of brucellosis affected herds, herds at risk, and other epidemiologically significant herds. It can locate affected premises and relate herd populations for negative, suspect, and reactor animals,

and find proximity distances from affected herds to nonaffected herds. It can select information from the BRRS Oracle database about any specific parameter and add the information to a map overlay of digitized features such as land contour, fences, vegetation, or hydrology.

The section VMO, epidemiologist, or area manager can then, more effectively, evaluate the data and make herd cleanup recommendations. Virtually any selected data from the BRRS Oracle database can be combined with any of the map feature overlays to make a new map overlay. The BRRS data can be displayed on the map as raw data, or in the form of pie, bar, or line graphs. The map overlay can be enlarged to a sufficient scale so that the individual can deal with only the desired area of consideration, such as a single county, a single township, or a single premises.

The Geographical Information System that has been selected is Genamap, produced by Genasys in Fort Collins, Colorado. It is very comprehensive and has many of the desired features that a GIS should have to meet the mapping needs for the section VMO, the epidemiologist, and the area manager.

As the Florida pilot project progresses and the usefulness of digitized maps as an analytical tool is evaluated for its ability to assist epidemiologists and VMO's in the control and eradication of brucellosis, a determination will be made about the level of mapping detail that is most beneficial. As users of GIS become familiar with the computer's analytical capability, they may find that communicating the severity and spread of brucellosis becomes easier through the use of maps created by an automated mapping Geographic Information System.

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Survival of Pseudorabies Virus in the Presence of Selected Diluents and Fomites

by

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The economic impact of pseudorabies, a herpesvirus infection, on the swine industry reportedly exceeds $21 million a year. A national pseudorabies eradication program has been proposed and studied. Although the majority of cases of pseudorabies are thought to be transmitted by close contact with nasal secretions or aerosolized nasal secretions of infected swine, inanimate objects may potentially serve as vehicles of transmission over larger distances.

The purpose of the current study was to examine the viability of pseudorabies virus under the following conditions: in animal waste products, in effluent from waste handling systems, in water samples, and on mixtures of selected diluents and fomites.

Survival of pseudorabies virus in various diluents and on solid fomites at 25 C was studied. Suspensions of the virus in the diluents saline-G and phosphate buffered saline remained infectious for 10 days. Infectivity of other virus/diluent suspensions decreased to less than 10 plaque forming units per milliliter in 14 days (swine urine), 7 days (well water), 4 days (swine saliva), 2 days (lagoon water and swine nasal washings), and 1 day (swine pit effluent, chlorinated water, and bile). Suspensions of pseudorabies virus in saline-G and on the solid fomites whole corn and steel remained infectious for 7 days. Infectivity of other virus/diluent/solid fomes combinations decreased to less than 10 plaque forming units per milliliter in 7 days. The role of the fomites as vehicles for transmission of infection was discussed.

Basic Principles for Eliminating Brucellosis from a Dairy Herd

by

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Many veterinarians have experienced the frustration that can arise when attempting to eradicate brucellosis from a dairy herd. The practice of concentrating cattle in large dairy herds, and the year-round calving, requires extra effort to reduce exposure of the cattle to the *Brucella* organism and to enhance their immunity. Vaccinating calves with *Brucella abortus* strain 19 vaccine is considered by many veterinarians to be an essential element of a herd plan to eradicate brucellosis. But the immunity provided by strain 19 vaccine can be overcome by the high level of exposure that may occur in an infected herd. The following principles have been used successfully in infected dairy herds by the author and others to reduce the exposure of noninfected cattle to the disease and ultimately eliminate the disease from the herds.

Adult Vaccination (AV)

The key to eliminating brucellosis from a herd is to eliminate the events that increase exposure of susceptible animals to the etiologic agent. Therefore, the main thrust of a herd plan must be to reduce the number of organisms shed at calving and the number of abortions that occur. Vaccinating all of the female cattle in a herd is the procedure that will accomplish this goal with the least effort. Both the replication of the organism and the probability of abortion occurring are generally reduced in a vaccinated animal that subsequently becomes infected. These two benefits of strain 19 vaccine result in reducing the number of *Brucella* organisms shed into the environment and a reduced threat to the remainder of the herd[1]. It is essential that all of the eligible animals in a herd be vaccinated. Nonvaccinated cows in an infected herd that is partially vaccinated have a higher probability of shedding enough organisms at abortion or calving to override the immunity of the vaccinates. Vaccinating all females over 12 months of age in an infected herd has been shown to be an effective tool in eliminating brucellosis[2] and has become a standard part of the eradication programs in several states. However, the vaccine alone will not eradicate brucellosis. It must be used in conjunction with other procedures to be fully effective[1].

Increased Frequency of Testing the Dry Herd

After the initial reactors are removed from a herd, the pregnant animals incubating the disease pose the primary threat to the noninfected cattle. Retesting the entire herd about 30 days after the initial test (unless adult vaccination was immediately utilized) is recommended to detect those lactating animals in the third trimester of pregnancy that will seroconvert after the first test. Once this is accomplished the dry herd should be concentrated on to eliminate the disease reservoir before further spread occurs through calving or abortion. The testing frequency should be based on the shortest time a cow will normally spend in the dry herd. If a producer typically keeps cows in the dry herd for six to nine weeks, a three-week testing interval is recommended. This will insure the individual animals receive at least two tests prior to calving. The milking herd can be set

up on a 60- to 90-day testing schedule once the majority of the late-term incubators are removed from it. Reducing the handling of the lactating herd is appreciated by most dairy producers. This procedure is most effective when combined with AV since the risk of abortions occurring in the lactation unit is greatly reduced.

Use of the PCFIA Test

The capability of this test to detect infected animals earlier than the standard agglutination tests has been described by Reynolds[3]. This early detection capability enhances the removal of infected animals before they can spread the disease. Some owners may elect to separate the suspects for retesting while others will send them to slaughter to eliminate any chance of exposing the rest of the herd. Serological suspects that are retained should be held apart from the herd until after they calve and additional tests and milk culturing are conducted.

Testing Fresh Cows

Fresh cows should be maintained as a unit until they are tested, since some infected cows do not react to the serological tests until after calving or aborting. Implementing this procedure will limit exposure to only the fresh cows, instead of, potentially, the entire herd. An exposed fresh cow that becomes infected should react to the tests before she is again added to the dry herd at the end of lactation. This procedure can virtually eliminate exposure of the lactating herd when combined with frequent testing of the dry herd. Not utilizing this option creates the potential to infect lactating cows that will soon be entering the dry herd. There they can maintain the disease reservoir and prolong the quarantine period.

Phasing Out the Dry Herd

The value of this procedure in eradicating disease by eliminating its reservoir has been documented by Del Rio Vargas[4]. As cows are dried off, a new dry unit is created separate from the existing one that has experienced exposure to the disease. The established dry herd is then gradually phased out of existence as the cows calve. The cows being dried off will have been tested multiple times in the lactating herd and will be tested frequently in the new dry herd. As a result, animals experiencing a long incubation period should be detected before calving again. In the event that exposure does occur, the new unit should also be phased out. Some owners may wish to combine such a unit with the previously exposed unit if it is still in existence. As the process is repeated, the probability is reduced that exposure will occur in the newly established unit. This procedure will also allow the contaminated dry herd pen or pasture to be cleaned either physically or by time and sunlight before more cows are put into it.

Individual Calving Pens

Placing cows in isolation pens for calving will assist in eliminating exposure and enhance the brucellosis eradication process in a herd[4]. The pens should be designed to prevent exposure between adjacent animals and each pen must be thoroughly cleaned and disinfected before the next cow is placed in it.

Small Calving Groups

An alternative procedure to individual calving pens is placing three to five cows together for calving. If one animal is infected, she will expose only a small number of cows instead of the entire dry herd. Although not as effective as the preceding procedure, this is an improvement over allowing the cows to calve in the dry herd.

Testing the Heifers at Breeding and Before Calving

This process will detect some of the infected heifers. Removing these animals before they can expose others will result in fewer reactors in the future.

The degree of difficulty and the amount of effort required by a producer to implement each of these procedures varies. Not every dairy producer will be able to apply all of them. Some producers will consider the cost of a procedure to outweigh the benefit. However, the effects accumulate for each one that is utilized.

Adult vaccination is the principle that provides the greatest return for the time and physical effort expended. Frequent testing of the dry herd is next on the same scale of comparisons. Both of these procedures are essential to eliminate brucellosis from a dairy herd in a relatively short time frame. The other procedures will reduce both the losses and the length of quarantine and are strongly recommended for any herd owner who is able to implement them.

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Wildlife Surveillance for the Amblyomma variegatum Pilot Eradication Project on Antigua, West Indies

by

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Abstract.--Wildlife surveillance for the *Amblyomma variegatum* Pilot Eradication Project on Antigua, West Indies, began in September 1988. Objectives of the wildlife study were (1) to determine if wildlife on Antigua are hosts for *A. variegatum* and, if so, be able to measure changes in the infestation of selected wildlife species relative to the eradication project, (2) to determine which wildlife hosts are migratory and therefore could be involved in the dissemination of *A. variegatum*; and (3) to make observations as to the relative abundance of wildlife on Antigua. Field studies were conducted in September-October 1988; May-June 1989; September-October 1989; and May-July 1990. Mongooses (*Herpestes auropunctatus*) and cattle egrets (*Bubulcus ibis*) were evaluated each season for infestation by *A. variegatum*. Small numbers of larvae and nymphs were found on both the mongooses and cattle egrets, but no adult ticks were found on any wildlife species. Data on mongoose population densities and bird abundance have been obtained and can be applied to the evaluation of pesticide use. The potential for dissemination of *A. variegatum* by cattle egrets is being evaluated through studies of host status and an evaluation of inter-island movement patterns. Cattle egrets are being captured alive, banded with U.S. Fish and Wildlife Service bands and large color- and number-coded plastic leg bands, marked with an island-specific colored dye, and released. Movements of birds from Antigua to Guadeloupe, Guadeloupe to Antigua, and from both Antigua and Guadeloupe to Martinique have been confirmed. Studies on the potential role of cattle egrets as disseminators of *A. variegatum* will continue through June 1991.

Possible Wildlife Source for Brucellosis in Domestic Livestock

by

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The following is an older but interesting case history from an epidemiological viewpoint. The index herd was literally eliminated because of brucellosis and almost 5,000 head of surrounding cattle were tested in an effort to locate and eliminate the source. A source was never proven, but epidemiological evidence suggests wildlife.

This particular herd, located in Northwest Wyoming, experienced abortions in the late winter of 1982. The owner had a local veterinarian bleed two of these cows that aborted and submit these samples along with an aborted fetus to the Wyoming Diagnostic Laboratory on 16 March 1982. The serology was classified as positive for brucellosis and the culture results from the aborted fetus yielded *Brucella abortus* type 1 (old nomenclature) which was confirmed and biotyped by NVSL.

There had been no cattle purchases for a number of years. The herd files in the Wyoming Livestock Board office indicated various partial herd tests since 1973 by the local veterinarian for sale/show and milk ordinance requirements with no evidence of any problems, and very little calfhood vaccinating using Strain 19.

On 16 January 1980, three yearling buffalo heifers and three yearling buffalo bulls were brought in from the state of Wyoming-owned buffalo herd located at the Thermopolis State Park. These animals were the seed stock for the buffalo portion of the index herd. (The above was a contractual agreement between the state and certain residents/landowners who met certain requirements and were interested in developing their own private herds of buffalo).

The cow herd ran in a grazing association with 10 other cow herds during the summer grazing period and the buffalo stayed on the owner's privately owned land. There were two additional cow herds having fence contact with this herd but not associated with the grazing association.

The index herd consisted of 48 cows, 2 bulls, 12 nonvaccinated heifers born the previous year, and 15 buffalo. The testing of this herd went as follows:

Cattle - diagnostic test - 2 tested - 2 positive - 16 March 1982
Cattle - cow herd only - 46 tested - 11 positive - 29 March 1982
These 13 positives were branded and shipped to slaughter, leaving 35 cows.

Cattle - heifers - 12 tested - 5 positive - 9 April 1982
Cattle - complete herd - 49 tested - 45 positive - 7 June 1982
(35 cows, 33 positive; 2 bulls, 1 positive; 12 heifers, 11 positive)
Heifers were spayed and shipped to quarantined feedlot while all positive adults were branded and shipped to slaughter. The remaining three head of cattle (two cows and one bull) were retested through 17 August 1983 and stayed negative.

Buffalo - 15 buffalo (yearling to 3 1/2 year olds) tested - 4 October 1982
All were serologically positive and were depopulated. Culturing was done on selected tissues revealing *Brucella abortus* type 1, which was confirmed and biotyped by NVSL.

During the late fall and early winter of 1982, the 10 herds in the grazing association were tested revealing 1 reactor, 1 suspect, and 4,722 negative cattle. The two fence contact herds were also tested revealing 144 negative cattle. The suspect was retested negative. The one reactor from a separate herd was a purchased import from another state during the spring of 1981. Milk culturing resulted in the isolation of *Brucella abortus* type 1, again confirmed by NVSL. This particular animal (which was tested negative before being imported as well as being quarantined and retested negative) could have been a latent reactor, or possibly exposed from the index herd the previous year, or exposed from the same source as the index herd. This herd with the singleton reactor was retested four additional times with no additional evidence of infection. The buffalo herd in the state park was tested to reconfirm its status and it was negative. To date, there has been nothing to indicate any infection exists in any of the involved herds. The contact herd testing was done approximately one year after the last possible exposure.

In this particular part of Wyoming, it is not uncommon for the snow to get four feet or more deep on the level during the winter. Consequently, animals are concentrated in a small area and routinely fed on the ground. It is also quite possible for elk to mingle with livestock and share feed during this time. This particular owner readily admitted that he saw the elk mingling with his cattle and buffalo and really enjoyed this "winter-wonderland" view from his home.

A source of brucellosis was never proven in this herd, but we feel that wildlife (elk) were the most probable source. (Elk in this geographic area of the state are known to be infected with *Brucella abortus*.) This outbreak is the first in Wyoming where extensive testing along with the epidemiological investigation points to wildlife. Since this time, there have been a couple of additional epidemiological cases indicating wildlife as a probable source.

Epidemic of Bovine Tuberculosis Cases Originating from an Infected Beef Herd in Oklahoma

by

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Although the prevalence of bovine tuberculosis has diminished in the United States, there have been surprising recent discoveries of the infection in Pennsylvania (1989), North Dakota (1988), New Mexico (1985), and Mississippi (1983).

In October 1989, an aged beef-type cow of Oklahoma origin was found tuberculous by U.S. Department of Agriculture (USDA) inspectors during routine postmortem inspection at a Missouri slaughter establishment. Procedures, progress, and results of investigations subsequent to the finding of the tuberculous slaughter-cow are reported.

The tuberculous cow came from a herd of beef cattle (Herd A) in northeastern Oklahoma. The cow had been purchased by Farm A from a neighboring farm (Farm B) in October 1988. All cattle on Farm B were dispersed at the time Farm A acquired the tuberculous cow. All known sales of cattle from Farm B were investigated. Eleven additional cases of tuberculosis were discovered--one in Kansas and 10 in Oklahoma. More than 5,000 cattle on more than 50 premises (seven states) were exposed to the infection. The source of the infection for Farm B is still under investigation.

The epidemic of tuberculosis cases in the current study stressed the importance of surveillance by USDA inspectors at slaughter establishments as well as rapid and decisive action in bovine tuberculosis eradication efforts.

Risk Communication: Trying to Prevent a Crisis with BSE

by

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Abstract.--One of many federal government duties is protection of the health of the American public as well as its livestock. The U.S. Department of Agriculture (USDA) in particular has been given responsibility in areas of food safety and animal health. During a Leadership Development Fellowship at the National Center for Food and Agricultural Policy the perception of USDA methods was one of not being responsive, but reactive. Individuals outside the USDA often view our organization as behind the times scientifically and as crisis managers, not as an agency that could prevent a crisis. What are the needs of our agency to communicate risk, either real or perceived, to the general public or any sector of the agricultural industry? As part of a self-directed activity, I examined what actions an agency might take to prepare itself for an actual dilemma. The dilemma chosen is the public concern over bovine spongiform encephalopathy.

Epidemiologic Investigations of Enzootic Vesicular Stomatitis on Ossabaw Island, Georgia

by

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Ossabaw Island, Georgia, is the only confirmed area of enzootic vesicular stomatitis New Jersey type (VSNJ) virus in the United States, and has been the subject of intensive surveillance since 1981. Serological evidence of VSNJ virus infection on this barrier island was first observed in 1965 (Jenney et al. 1970), and since that time, serum neutralizing antibodies have been detected in feral swine, white-tailed deer, raccoons, cattle, horses, and donkeys (Fletcher et al. 1985; Stallknecht et al. 1986; Stallknecht and Erickson 1986).

Since 1982, we have been serologically monitoring both the wild swine and white-tailed deer populations. Serial bleeding of sentinel wild swine indicates that VSNJ virus activity is extremely localized and varies considerably by year. Onset of seroconversions consistently begins from May to early June and continues into September. Although annual seroconversion rates in swine can exceed 80%, clinical vesicular stomatitis is not readily detected (Stallknecht et al. 1985, 1987; Corn et al. 1990). Antibody prevalence in white-tailed deer parallels results from swine. Spatial analysis of serological results from deer indicate a strong localized effect with highest antibody prevalence associated with old-growth maritime forest.

Work with sentinel domestic swine on Ossabaw Island (Stallknecht et al. 1987) and subsequent VSNJ virus isolation from *Lutzomyia shannoni* implicated this phlebotomine sand fly species in the epidemiology of this virus (Corn et al. 1990). Laboratory studies with *L. shannoni* have since demonstrated VSNJ virus replication and transovarial transmission in this species as well as bite transmission to laboratory hosts (Comer et al. 1990). However, the low frequency of infected F1 progeny suggests that maintenance of VSNJ virus may require an amplifying host.

In order to assess the potential role of wild swine as an amplifying host for VSNJ virus, virus isolation attempts were incorporated into our sentinel wild swine surveillance during 1990. A subsample of 59 juvenile swine were monitored weekly with virus isolation attempted from nasal swabs, tonsil swabs, and whole blood. From May to July 1990, 21 of these swine seroconverted with VSNJ virus isolated from nasal swabs of five animals. Although virus infection appeared to be transient in individual swine, VSNJ virus was present on a longterm basis in the herd. Additional work is needed, however, to determine if infected swine represent a viable source of VSNJ virus to feeding *L. shannoni*.

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Preliminary Epidemiological Findings in a Flock of Scrapie Exposed and Infected Sheep

by

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Introduction

The Scrapie Source Flock is a combination of three flocks, one each from Iowa, Michigan, and Indiana. All three flocks were exposed to and became infected with natural scrapie in the field and were brought to the Scrapie Investigation Center.

The Indiana flock, consisting of 33 ewes, arrived at Mission on 27 May 1988 and became a part of the source flock 23 February 1990. The Indiana sheep sent to Mission were all believed to be exhibiting scrapie signs. Since May 1988, 19 ewes have died, of which 14 were examined histopathologically. Of these, four ewes were positive and one suggestive of scrapie on histopathology. Only one of these sheep was found to be positive after the flock was combined in Mission.

The Iowa and Michigan flocks were brought to Mission on 26 January 1990 and became members of the source flock at that time. The 39 ewes of the Iowa flock are all related through the female line to one of 11 confirmed scrapie positive ewes. Eight of theses ewes were a part of the Iowa flock at the time of their deaths. The entire Michigan flock of 29 ewes and 17 yearling ewes was brought to Mission.

Methods

From the time the sheep arrived at the Scrapie Investigation Center they were observed during routine care for signs of scrapie. Using this method, scrapie sheep were not detected until they were in the later stages of the disease, so starting on 20 June 1990 the sheep were observed three to five days a week from morning feeding until rubbing was no longer observed, approximately one hour. Number of rubbing events during each consecutive set of 10 observation dates was calculated.

All sheep that died were necropsied. Brain tissue was examined histopathologically at NVSL by Dr. Bill Taylor. Brain tissue from cases that were clinically positive but histopathologically negative or suspicious were tested for prion protein by Dr. Richard Race at Rocky Mountain Labs. Based on these observations and laboratory tests, each sheep was placed in one of the following classes:

- Laboratory confirmed positive--positive on either histopathology or prion protein testing
- Clinical positive--sheep showing persistent neurological signs
- Clinical suspect--rubbing observed on 30% or more of the observation days since the initial increase in rubbing

- Clinical negative--less than 30% rubbing

Results

On 23 February 1990 the source flock consisted of 107 ewes. To date 27 ewes have died. Of these, eight were clinically positive for scrapie; four of these were positive on histopathology; one was negative and one was suggestive on histopathology, but both were positive on prion protein testing, and two are pending test. Four of the dead ewes were clinical suspects and are still pending test. Mortality rate from 26 January 1990 to 7 November 1990 are shown in Fig. 1. Currently, of the remaining 80 ewes, 5 are clinically positive, 12 are clinically suspicious, and 63 are clinically negative.

The first case occurred 14 March 1990. Incidence of clinical positives increased steadily from 0.9% in March to 5.4% in July and then decreased to 0% in August. The drop in August is probably due to the long course of the disease and the fact that neurological signs usually occur late in the course of the disease (onset was defined as the first date on which persistent rubbing or neurological signs was seen). Prevalence of clinical positives increased from 0.9% in March to 11.5% July. For the same reasons as incidence and because four of the positive ewes died, prevalence fell off after July (Table 1).

Table 1. *Monthly incidence of clinical positives and prevalence of clinical positives.*

Month	Percentage of incidence clinical positives	Percentage of prevalence clinical positives
January	0.0	0.0
February	0.0	0.0
March	0.9	0.9
April	1.9	2.8
May	2.0	3.8
June	4.0	6.2
July	5.3	11.5
August	0.0	9.6
September	0.0	7.8
October	0.0	7.9

All of the laboratory confirmed positives that died after 20 June 1990 consistently showed a minimum of three observations of rubbing during each consecutive set of 10 observation days with an average of 5.6 and a peak of 9. Lip movements while rubbing were observed on at least one occasion in each of the sheep. All the confirmed positives have displayed one or more of the following neurological signs: incoordination and weakness of the rear legs, stilted rear movement, loss of balance while turning (sometimes resulting in falling), bunny hopping at a fast gait, tremors of the face, and eventually inability to rise.

Frequency of rubbing varies considerably from one observation period to the next; however, the trend is upward.

Discussion

Using the chi squared test the only statistically significant finding was sire in the Iowa flock with $P = 0.003$. While not statistically significant there seemed to be some correlation with maternal family ($P = 0.087$) and age ($P = 0.35$; if only lab confirmed cases are used, $P = 0.127$). It is interesting to note that the degree of relationship (no unrelated ewes were available for comparison) to a scrapie effected ewe is not significant ($P = 0.493$). The difference between flocks was not statistically significant ($P = 0.129$). The presence of persistent neurological signs correlates well with testing positive on histopathology or PrP. It also appears that persistent rubbing may correlate well with being lab positive, but many more cases will have to be studied before this finding can be considered significant. These findings must be considered preliminary until the status of each sheep is known at the conclusion of the study. The sheep that are currently categorized as not clinically positive may become positive and significantly affect the data.

Tables.

Iowa Flock

Age in Years

Age year	Clin. pos.	Not clin. pos.	Total	Rel. risk
2	1	14	15	1
3	3	6	9	7
4	1	5	6	2.8
5	1	8	9	1.75
	6	33	39	

Maternal Family

Family	Clin. pos.	Not clin. pos.	Total	Rel. risk
1	0	2	2	
2	0	2	2	
3	0	4	4	
4	0	4	4	
5	2	0	2	
6	0	2	2	
7	3	7	10	2.1
8	0	5	5	
9	1	5	6	1
10	0	1	1	
11	0	1	1	
	6	33	39	

Sire

Sire	Clin. pos.	Not clin. pos.	Total	Rel. risk
1	1	3	4	2.7
2	0	1	1	
3	3	0	3	
4	0	4	4	
5	0	5	5	
6	0	2	2	
7	0	6	6	
8	1	8	9	1
9	1	0	1	
10	0	1	1	
11	0	1	1	
12	0	1	1	
	6	32	38	

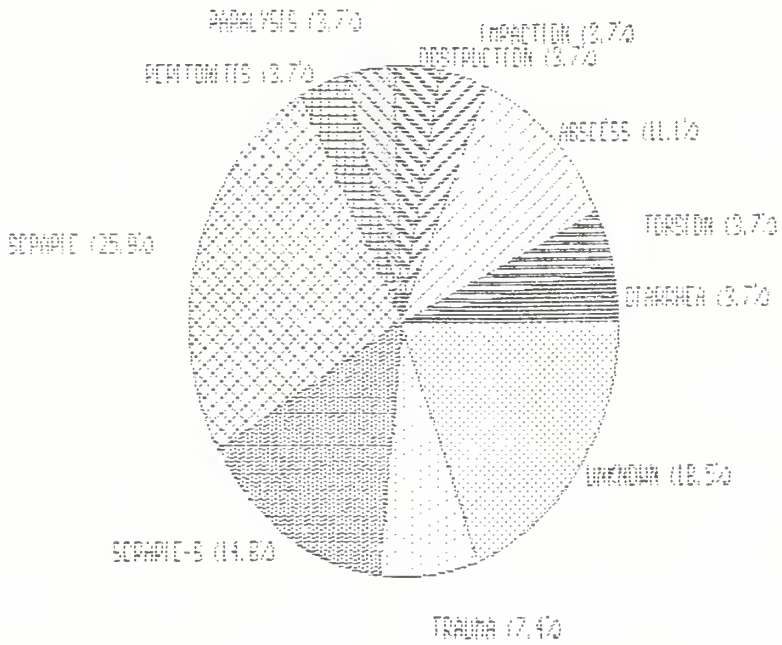
Relationship to Scrapie Positive Ewe

Relation	Clin. pos.	Not clin. pos.	Total	Rel. risk
Daughter	1	3	4	4
Dam	1	12	13	1
Grandam	3	8	11	4.5
Sister	1	10	11	1.2
	6	33	39	

CAUSE OF DEATH IN

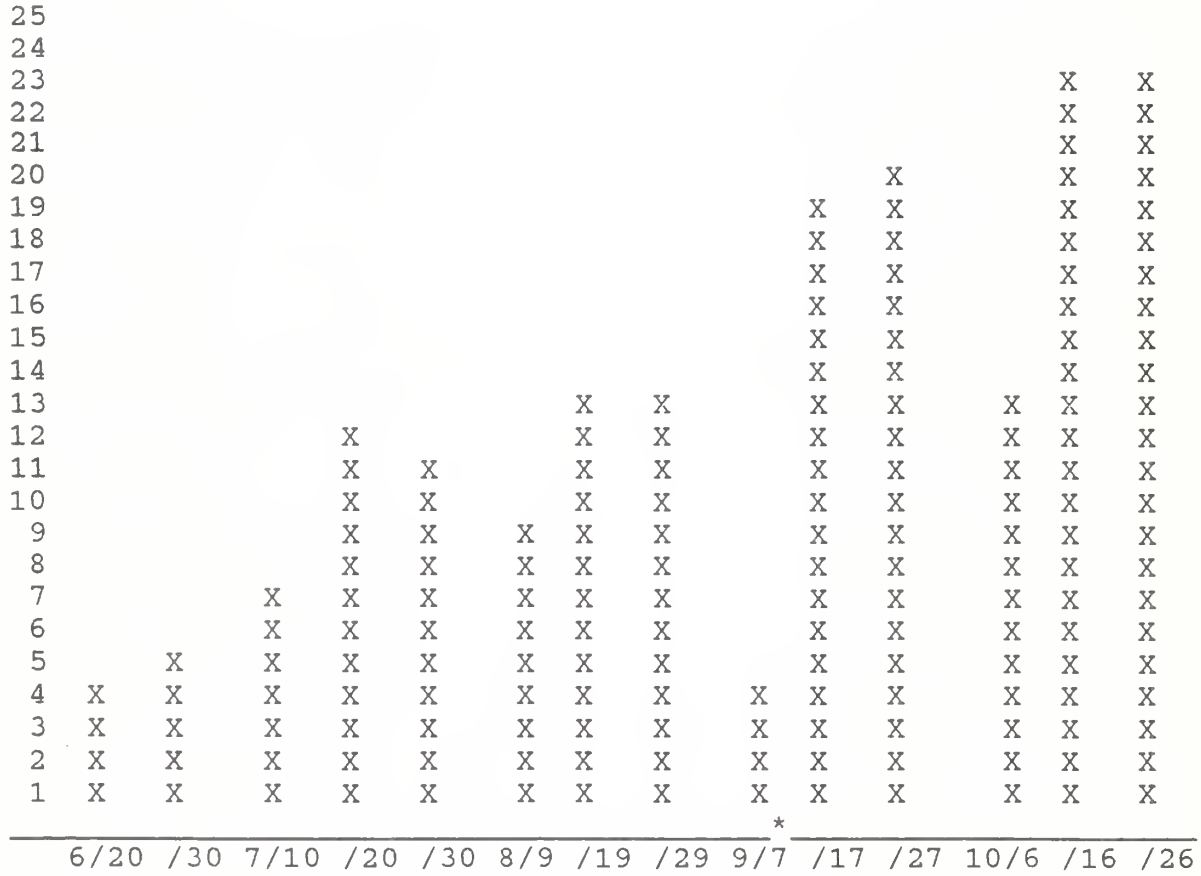
A SCRAPIE EXPOSED AND INFECTED FLOCK

1\26\90 TO 11\7\90



DEATHCAUSE	Freq	Percent	Cum.
DIARRHEA	1	3.7%	3.7%
TORSION	1	3.7%	7.4%
ABSCESS	3	11.1%	18.5%
IMPACTION	1	3.7%	22.2%
OBSTRUCTION	1	3.7%	25.9%
PARALYSIS	1	3.7%	29.6%
PERITONITIS	1	3.7%	33.3%
SCRAPIE	7	25.9%	59.3%
SCRAPIE-S	4	14.8%	74.1%
TRAUMA	2	7.4%	81.5%
UNKNOWN	5	18.5%	100.0%
Total	27	100.0%	

AVERAGE RUBBING EVENTS PER 10 DAYS

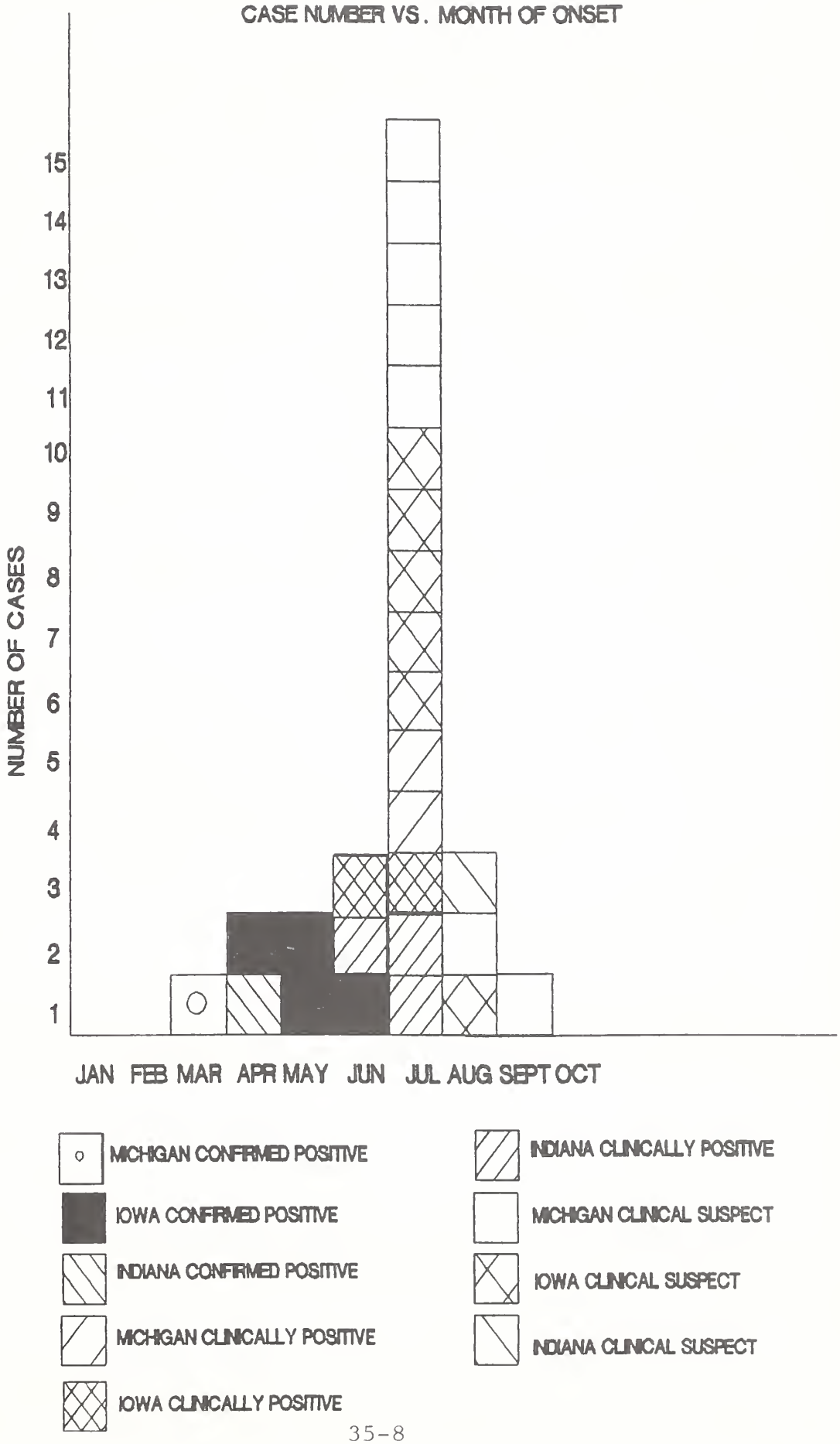


* Observations made by different observer

Sheep were stratified by flock of origin, and in the Iowa flock were records were sufficient by age, family, sire, and degree of relationship to known positives.

FLOCK OF ORIGIN

FLOCK OF ORIGIN	LAB POS	ALIVE OR NEG	TOTAL	REL. RISK
IOWA	4	35	39	4.7
INDIANA	1	21	22	2.1
MICHIGAN	1	45	46	1
	6	101	106	


CASE NUMBER VS. MONTH OF ONSET
NUMBER OF CASES
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT
MICHIGAN CONFIRMED POSITIVE
IOWA CONFIRMED POSITIVE
INDIANA CONFIRMED POSITIVE
MICHIGAN CLINICALLY POSITIVE
IOWA CLINICALLY POSITIVE
INDIANA CLINICALLY POSITIVE
MICHIGAN CLINICAL SUSPECT
IOWA CLINICAL SUSPECT
INDIANA CLINICAL SUSPECT

Sentinel Herd Study of Bluetongue Virus in Puerto Rico

by

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Preliminary Results 1990

In January 1990, the Commonwealth of Puerto Rico and Veterinary Services of the U.S. Department of Agriculture/Animal and Plant Health Inspection Service (USDA/APHIS) were approached and asked to participate in an ongoing prospective regional study of bluetongue virus. The region under study also includes the countries of Barbados, Costa Rica, El Salvador, Guatemala, Honduras, Jamaica, Nicaragua, Panama, and Trinidad and Tobago. In addition to the participating countries, co-sponsors include the University of Florida and the University of Wisconsin, the Interamerican Institute for Cooperation in Agriculture, the USDA Agricultural Research Service, and the Organismo Internacional Regional de Sanidad Agropecuaria.

Initially, three sentinel dairy herds were chosen to represent the various geographical parts of the island, and at the same time, three of its many different environments. The first farm in Mayaguez is a large Holstein dairy in a river flood plain. The second farm is in Sabana Grande. This is inland, in an area of Caribbean Tropical Dry Forest. The dairy is primarily stocked with Brown Swiss cows, although there are some Zebu cattle on the farm. The third dairy is located in Naguabo and is in a lush area of foothills around the mountainous Caribbean National Forest. It is a Holstein dairy; the calves are kept together in an elevated building under which swine are kept to recycle the calves' waste which falls through the floor.

In all three sentinel herds, 20-25 three-month-old calves were selected. Blood was collected in both heprinized and clot tubes from the jugular vein each month. These samples were ice packed and sent to the Costa Rican veterinary laboratory by air. Samples were first collected in February 1990 and continue to be collected at this time. If seroconversion was detected by AGID of the clotted sample, then the heprinized tube from the same sampling date and that of the previous month were processed for virus isolation. The calf, once seroconverted, was replaced by another calf three to four months old.

In August, a fourth dairy in Isabela was tested after signs of clinical disease were detected. The owner introduced 175 imported heifers of Pennsylvania origin in July 1990. Approximately one month later, his private veterinarian submitted serum of a cow with mouth lesions to NVSL. Serum was also submitted for a second cow which had aborted at about the same time. Also noted at the dairy was a cow with severe swelling of all four limbs; this cow died and was not available for testing. A second serum sample for both cases was taken one month later to compare titers. Whole blood of 19 randomly selected animals was sent for virus isolation.

In the Mayaguez farm, a total of 39 different calves have been tested; this is due to attrition of animals to death, theft, or conversion to seropositive status. Of the 39 calves, 11 showed the classic pattern of a period of positive titer due to maternal antibodies,

followed by a period of no titer, in turn followed by a period of positive titer due to exposure and self-produced antibodies. Two other animals failed to demonstrate maternal antibodies, but nonetheless converted from negative to positive titers. These two groups were replaced with new calves and the sera sent for virus isolation. Of the 39 calves, a group of 20 animals are negative at present and are still being tested to determine seroconversion; of these calves, 11 did not demonstrate maternal antibodies. Three calves were consistently positive and were replaced. While there have been only 13 seroconversions, and to assess seasonal occurrence would be premature, there does seem to be two peaks in seroconversions: May (three calves) and September (five calves). Both of these months were marked by an increase in precipitation. There was a peak at seven months of age for seroconversion of the calves (five calves). In this farm, this may be significant because young animals have been added throughout the study and the age of the group is not related to the season of the year.

In the Sabana Grande farm, there have been to date only four seroconversions. Two of these animals always tested positive and the date of seroconversion is assumed because of virus isolation. Of these four animals, only one was found originally to have maternal antibodies. Four other animals were consistently positive and therefore, replaced. Of the 25 remaining animals still in the study, 13 originally demonstrated maternal antibodies and all are negative serologically as of October 1990.

The farm in Naguabo is significantly different from the other two cohort farms for several reasons. First of all, except for three calves which seroconverted in June, most of the animals (23 calves) seroconverted in August. This presumably correlates to the usual beginning of the fall rainy season. Because all animals were nearly the same age initially, and because they remained intact as a cohort for the whole study to that point, there would be little relevance to the fact that 18 animals seroconverted at the age of nine months. Of the animals to seroconvert, over half initially showed maternal antibodies.

In the paired samples taken from the two clinical cases in dairy heifers, at the auxiliary farm in Isabela, all were positive in the AGID test, and in both animals, significant changes in titer levels to specific bluetongue serotypes were noted. In the animal which had aborted, there was an eight-fold decrease in titers between the two samples for bluetongue serotype 17. This serotype we know was infecting cattle in another part of the island in February 1990. The animal found with tongue and mouth lesions demonstrated four-fold changes in titer levels for serotype 2 (decrease) and 13 (increase).

To date, there have been only two isolations of bluetongue virus from the Puerto Rican samples. In the February samples from the Sabana Grande farm, two calves were positive for bluetongue virus, serotype 17. This was the first time the virus had been isolated in Puerto Rico, and the first time that serotype 17 had been isolated in the Caribbean. Results of viral isolation from the blood samples of the Isabela farm are not known at this time.

Data on the insects trapped at the Mayaguez and Naguabo farms are compiled more slowly, and at this point there are results only through May 1990. However, in the results that are finalized, *Culicoides insignis* is the most common species of the genus found at the two sites; this species has always been represented by at least twice as many individuals as the next most common species, *C. pusillus*. There are plans to attempt to recover virus from insects trapped.

Water Quality Results from NAHMS Iowa Rounds 2 and 3

by

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Water quality is becoming one of the most controversial topics concerning American agriculture. The media, elected officials, environmental groups, farm organizations, government agencies, and the average citizen are becoming concerned as to the current status and future projections for the quality of our nation's water supply. Water quality as an issue will not be resolved until factual, meaningful data can be gathered as to the status of our national water supply.

Many studies have been done, are ongoing, and are proposed to examine water quality. The Environmental Protection Agency (EPA) conducted a National Pesticide Survey in 1989 with a report to be released in 1990. In reaction to this survey, the American Farm Bureau Federation (AFBF) launched its own water quality survey. The intent of the AFBF is to have 100 times the number of water samples tested in each county surveyed by the EPA. The purpose of the AFBF survey is to gather enough data to either substantiate or refute any EPA findings.

In 1986, the Iowa State University College of Medicine and the National Animal Health Monitoring System (NAHMS) designed and entered into a cooperative program of animal health monitoring in the state of Iowa. The major objectives of the program centered on determining livestock disease prevalence and cost and developing a disease data base for the Iowa livestock industry. Environmental and biological specimens, including water, were also collected and analyzed. Data collection occurred during three distinct time periods referred to as "rounds." Water samples were collected during the second and third rounds. This paper will describe the collection process and the results of the analyses that were conducted.

State and federal veterinary medical officers (VMO's) were utilized in the collection of the data, biological specimens, and water samples. Their professional training ensured accurate sample collection through the use of standardized collection techniques.

Farm cooperator selections were random. The selection process was a cooperative effort between the Iowa State University Statistical Sampling Section and the state and deputy state statisticians of the Iowa Agricultural Statistics Office.

All water analyses were performed at the Iowa State University Diagnostic Laboratory and the National Veterinary Services Laboratory, Ames, Iowa. In Round 2, the water samples were collected in the fall of 1986 and the spring of 1987. In Round 3, the water samples were collected in the spring and fall of 1988.

Two liters of water were collected in the spring and fall from each source. One quart mason jars, with aluminum foil as a protective cover, were used as containers. Each jar was cleaned, acid rinsed, and fired before it was distributed for sample collection. Water samples were delivered to the university in insulated carriers the day of collection whenever possible. If same-day delivery was not possible, samples were refrigerated until

delivery the following day. Portions of the sample were maintained frozen at -18°C for trace element determination. A total of 302 samples were tested. Table 1 contains the components for which each sample was tested.

Table 1. *Water Test Components, NAHMS Iowa Rounds 2 and 3.*

Microtox*	Mercury	Carbamates	Solids
Organophosphates	Arsenic	Phosphorous	Selenium
2-4 D	Coliforms	Atrazine	Iron
Nitrates	Lead	Sulfate	Lasso
Zinc	Cadmium	pH	Magnesium
Chlorinated hydrochlorides	Calcium	Copper	Sodium

*A test designed to detect and quantify contamination by toxins.

Wells were the water source for livestock in more than 90% of the samples collected (Fig. 1). Because of the high public interest in well source water quality and the lack of samples from other water sources, only water samples originating from wells were considered in the following analysis.

Three components frequently exceeded the EPA's recommended levels in the well water samples collected (Fig. 2). Coliforms exceeded the EPA's levels in 18% of the samples. Nitrates and sulfates were excessive in 22% and 17% of the samples, respectively. Herbicides, pesticides, and heavy metals were detected only in trace amounts, but above EPA levels in about 2 of the well samples tested. On a per-well basis, coliforms, nitrates, and sulfates exceeded the EPA's levels in 33%, 31%, and 23% of the wells, respectively.

The EPA does not, at this time, regulate private wells. The primary reason for choosing the EPA standards was for national standardization of the results and as a basis for comparison with future studies. EPA drinking water regulations and health advisory values are provided in Table 2. Because of the large number of wells with negative results and a wide variability of positive results, this analysis only reports as positive (exceeds EPA recommended levels) or negative (within EPA recommended levels).

Table 2. *EPA drinking water regulations and health advisory values, NAHMS Iowa Rounds 2 and 3.*

	Coliforms[1]	Nitrates[1]	Sulfates[2]
Negative	<1/100 mL	<45 ppm	<250 ppm
Positive	>1/100 mL	45 ppm	250 ppm

[1]National Primary Drinking Water Regulation standards that are protective of public health
[2]Secondary maximum contaminant levels relating to color, taste, or smell of the water

The Round 3 survey indicated that the majority of Iowa wells are more than 25 years old (Fig. 3). Also, the majority of wells in Iowa are less than 100 feet deep (Fig. 4). More than 58% of the wells in the category greater than 25 years of age and less than 100 feet in depth had positive nitrate levels.

Of the samples from wells with depths less than 100 feet, 49% were used for household purposes. Of those used for household purposes, more than half (56%) had samples with nitrate concentrations above recommended EPA levels.

Positive sulfate levels were associated with increasing depth. Although the cause is not known, it could be related to Iowa soil type and topography. Coliform positives could not be related to depth or age.

With respect to well casing, analysis of the data from the NAHMS studies in Iowa could not detect a significant correlation between contaminant levels and casing type. However, it is interesting that all samples from the three wells cased with plastic did not contain sulfates, nitrates, or coliforms in concentrations above the EPA levels. The small number of wells prevented testing for significance as to the casing type. Additional consideration must be given to the age and depth of those wells. The use of plastic casings is a relatively new procedure and the Iowa data show that newer wells tend to be greater than 100 feet in depth.

The Iowa NAHMS studies served to refine the survey forms and procedures for the NAHMS National Swine Survey. Future analyses of this data and data collected during the National Swine Survey will examine the relationship of water quality to the health events observed in the swine in the Iowa study.

Figure 1: Sources of Water Samples
NAHMS Iowa Rounds 2 and 3

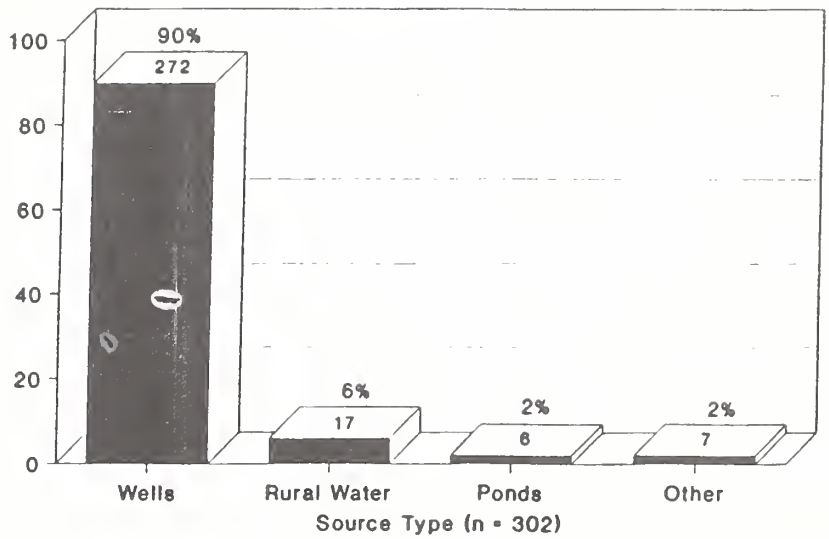
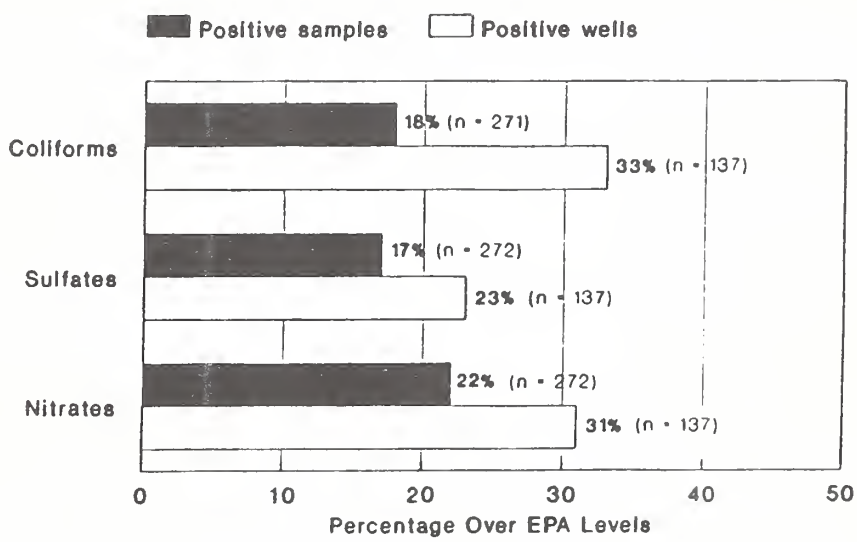


Figure 2: Coliform, Sulfate, and Nitrate Levels
NAHMS Iowa Rounds 2 and 3



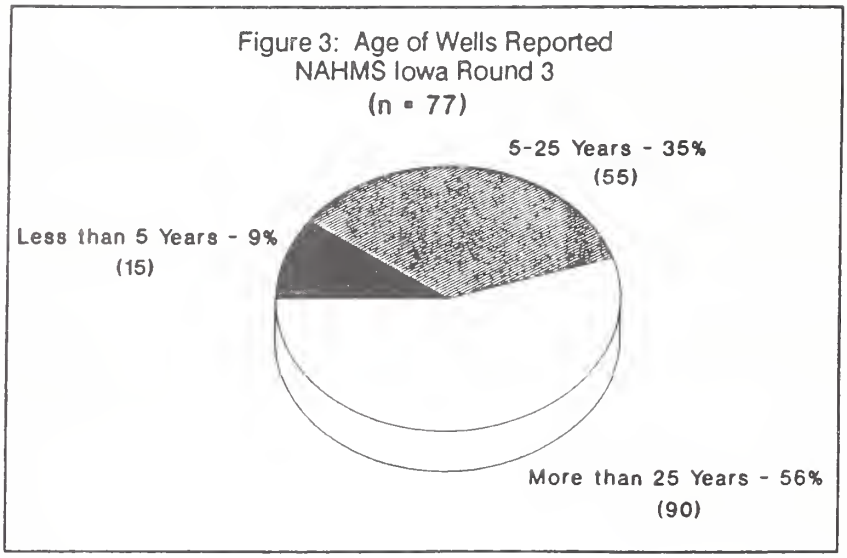


Figure 3: Age of Wells Reported
NAHMS Iowa Round 3
(n = 77)
5-25 Years - 35%
(55)
Less than 5 Years - 9%
(15)
More than 25 Years - 56%
(90)

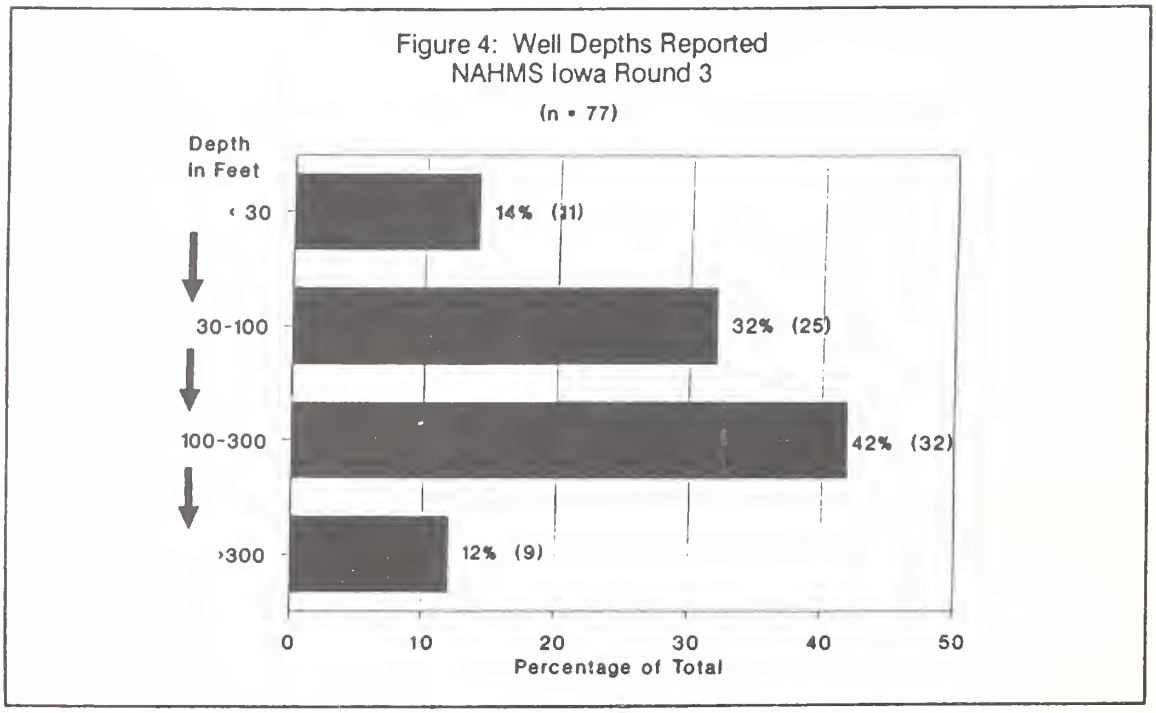


Figure 4: Well Depths Reported
NAHMS Iowa Round 3
(n = 77)
Depth
In Feet
< 30
14% (11)
30-100
32% (25)
100-300
42% (32)
>300
12% (9)
0
10
20
30
40
50
Percentage of Total

Use of Postmarketing Surveillance in Assessing Drug Safety

by

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The assessment of the safety of a new animal drug is a continuous process that takes place throughout the development, marketing, and postmarketing surveillance phases of a drug's lifetime. Each of these phases provides additional information on the safety of the drug; which is obtained through postmarketing surveillance. These phases are pivotal to the continued safe use of the drug. Surveillance requires continuous monitoring. This can involve a systematic collection, collation, and evaluation of relevant data.

Intrinsic in the concept is the regular dissemination of the basic data and interpretations to all who have contributed--and to all others who need to know[1].

The intent of postmarketing surveillance of an approved drug is the acquisition of information about events related to the use of the drug. It is crucial to the collection of new information essential for the appropriate use of the drug.

Obviously, surveillance is action-oriented since it has as its main goal the prompt initiation of steps for the control of a problem. I've applied the concepts of surveillance when reviewing data collected from drug residue violations. Epidemiology was also used to present a descriptive overview of the residue problem.

In the human drug approval process, the field of drug epidemiology has evolved over the past two decades to address the surveillance of drug safety in the postmarketing stages. Statistical methods have also played a major role in the design and analyses of cohort and case-control studies used to evaluate drug safety[2].

In the Center for Veterinary Medicine, we have been diligent to utilize postmarketing drug surveillance to describe the occurrence of adverse events associated with the use of an animal drug. Epidemiology provides a scientific approach for the proper collection and interpretation of postmarketing surveillance data on drug residues. Used in concert these tools can be used to assess risk to human food safety.

Human Food Safety and Risk Assessment

Risk has been termed the probability of injury, disease, or death under specified circumstances, and it may be expressed in quantitative or qualitative terms. In the former, it takes values from zero to one (certainty that harm will not occur to certainty that it will). In the latter--qualitative--risk can be described as high, low, or trivial. On the other hand, "safety" in its common usage means without risk. Thus, the safety of chemical/drug residues in food is a condition of exposure under which there is relative certainty that no harm will result in the exposed population. Risk assessment is an integral part of the approval process.

The drug approval process usually incorporates large safety factors within established tolerances. Thus, exposures to levels higher than the established tolerance does not

necessarily indicate serious risk. Our problem as scientist has been our inability to dispel some consumer perceptions concerning the presence of harmful residues in food animal products. We have done a poor job in risk communication. As a result, consumer fears about risk are in certain cases greater than what the scientific facts suggest is necessary.

In determining the impact of any chemical or drug on human health, two distinct elements have been identified; they are risk assessment and risk management. The term "risk assessment" is generally recognized to mean the characterization of potential adverse effects on human health from environmental hazards. Risk assessment includes several elements: hazard identification, dose-response assessment, exposure assessment, and risk characterization[3,4]. Hazard identification involves whether a chemical is causally linked to a particular health effect. Causal associations are difficult to assess with epidemiology studies. Dose-response assessment involves the relationship between the magnitude of exposure and the probability of occurrence of the health effects. Exposure assessment involves the extent of human exposure before or after the application of regulatory controls. Risk characteristics describe the nature and magnitude of human risk.

The term "risk management," when carried out by a regulatory agency concerned with food safety, refers to the decision-making process that includes the use of value judgments to determine the acceptability of health risks under a given statutory scheme. Risk management activities are based on information that is as accurate and complete as possible (scientifically sound).

The setting of tolerances (i.e., 0.1 ppm for SMZ) is an example of a risk management activity. In addition, the procedure for establishing the appropriate withdrawal period is a risk management decision.

Just as we are beginning to understand the interplay between risk assessment and risk management, a third element is being discussed within the Food and Drug Administration. I am referring to the concept of risk communication, which is lagging behind our knowledge base in risk assessment and risk management.

Risk communication is the purposeful exchange of information about risk. During this process interested parties must convey, transmit, or exchange information about levels of health or environmental risk, the significance of the science issues and decision, and actions or regulatory policies aimed at managing the risk[5]. Scientific information about risk can occur through a variety of ways. Communicating the science behind decision-making is an essential component of risk communication.

Conclusion

Postmarketing surveillance (PMS) involves monitoring a drug after the approval through the collection of adverse veterinary drug reaction reports, analyzing Establishment Inspection Reports relative to drug residue violations data, and conducting epidemiological studies. These activities are part of the drug development process because of inherent limitations of clinical trials. It is anticipated that PMS activities will increase in the future due to increasing consumer demand for more information about the safety of pharmaceutical products. Through PMS we will be able to provide information essential to the planning, implementation, and evaluation of policies necessary for residue prevention. The risks for most veterinary drugs in animal tissues are relatively small.

In order to change public perception regarding the safety of our food supply, we must begin to integrate the science process with an essential element of risk assessment, that of risk communication.

The veterinary profession along with the regulatory agencies must assume a greater responsibility in assuring the public that the supply of meat, milk, and eggs are free of unwanted drug residues.

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